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VOLUME THE SECOND

To be Published on the First of June.

A TREATISE

ON

DIET AND REGIMEN.

BY

WILLIAM HENRY ROBERTSON, M.D.

PHYSICIAN TO THE BUXTON BATH CHARITY.

Fourth Edition.

RE-WRITTEN AND MUCH ENLARGED.

IN TWO VOLUMES.

VOLUME I.

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PREFACE.

The first edition of this work was published more than eleven years ago; and the investigations and progress of modern Chemistry, and more especially in the great department of Organic Chemistry,—the laborious inquiries and able Reports of the Parliamentary Committees as to the sanatory condition of the people,—the able and full Reports on the sickness and mortality of the Army and Navy, in the Home service, and in the different colonies and dependencies of Great Britain,—have severally added to the materials which time, thought, and increased experience have served to collect. The result is, that the work has had to be entirely re-written, and its matter has been more than doubled in quantity; and I venture to hope, that it has been, at the same time, improved in character.

Too much cannot be said, and happily little need to be said, as to the claims of Dr. Prout, as the

early and successful cultivator of that great department of Chemistry, the Chemistry of Organisation; a department which is so peculiarly the production of these times, and so magnificent a proof of the energetic character of this age,—and which bears so important and intimate a part in fixing the true elements of health, and determining the nature and consequences of disease. And little need be said as to the claims of Dr. Southwood Smith, for his early, successful, and unwearying efforts in tracing the causes and circumstances of endemic and epidemic disease. Too much praise, moreover, cannot be given to all who have been engaged either in collecting the facts, or drawing up the Reports, on the sickness and mortality of the Military and Naval services, on the sanatory condition of the people, on the health of towns, on the extension and perfecting of the registration of births and deaths, and in the preparation of several similar valuable public documents, derived from extensive and various data, and from which such important conclusions may be eventually derived, as to the causes and prevention of disease, the preservation of health, and the prolongation of life. In the grateful enumeration of the chief benefactors to the science of

the age, so far as it bears upon the great primary question of the Public Health, the names of Liebig, Simon, and Mialhe, and those of Professor Brande, Dr. William Gregory, Dr. Lyon Playfair, Dr. George E. Day, and Dr. R. D. Thomson, perhaps deserve especial mention, on account of the amount or the value of their contributions. But, however much may hereafter be done in the extension and improvement of this important department of Chemistry, and however large the debt which the art of medicine may eventually owe to any and all of those engaged in such researches, the name of Sir Humphrey Davy, for what he did at a time that now seems comparatively long ago, must be connected in our respectful and grateful feelings with those of Dr. Prout and Professor Liebig, as having laboured early in this department, as having contributed largely to its facts, and as having paved the way to many of its more recent and important discoveries and conclusions. From this list of benefactors to the great cause of Public Health, it would be wrong to omit the names of Mr. Chadwick and Mr. Farr, the able Secretaries to the Poor Law Commission, and to the Registrar-General, who have so ably sifted, analysed, generalised, and enriched

with practical deductions, the facts collected within their respective departments.

The present edition of this work is prefaced by an introductory chapter on the origin, &c., of sporadic, endemic, and epidemic disease,—the influence of civilisation on human health and the expectation of life,—the importance of information on the physical necessities of health, and the principal sources of disease,—and the evils which arise from the general ignorance of the public on sanatory questions, and from quackery, which is the child of such ignorance. The body of the work contains chapters on diet,—ventilation, climate, and change of air,—the hygienic effects of clothing, &c., especially with reference to practical inferences,—the physiological effect of water on the system, when applied to the skin, and when taken into the stomach,—mineral waters,—sleep,—influence on health and life-expectancy of the combined physical causes, with reference to employment, town or country residence, &c.,—and on the effects of mental culture on health.

The Square, Buxton,
Derbyshire.

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Page 182, line 4 from bottom, *for* "Prout's" *read* "Proust's."

A TREATISE

ON

DIET AND REGIMEN.

CHAPTER I.

Introduction.—The Organic Laws.—Violation of these Laws the Cause of Disease.—Diseases divided, according to their Causes and Character, into Sporadic, Endemic, and Epidemic.—Effect of Civilisation upon Endemic and Epidemic Disease.—Its Influence on Sporadic Disease.—The largest Sanatory Gains only to be obtained by the active Co-operation of the People.—Duties and Responsibilities of Medical Men.—Public Enlightenment the able Antagonist of Endemic Diseases and of Quackery, which are equally the offspring of Ignorance and Neglect.

There can be no doubt that the duration of man's life and its healthiness depend upon the fulfilment of certain conditions, which are fitly called the organic laws. There is, moreover, no doubt, that the non-observance of these laws not only affects the healthiness, and shortens the duration, of the individual life, but includes, in direct proportion to the degree of such non-observance, the entailment

of infirmity on the offspring, involving a greater liability to disease, and a less expectation of life.

There may be said to be three principal ways in which the organic laws are violated;—the one arising from the acts of the individual, entailing on him, and perhaps on his posterity, the, as far as may be, isolated consequences;—the second, produced by the acts or neglects of a combination of individuals, involving injury to the health, and life-probability, of the body-politic;—the third, still more general, and chiefly depending on natural phenomena, as atmospherical conditions, and the like. To the first head, by way of illustration, may be referred disease of the liver, resulting from intemperance; to the second, fever, produced by imperfect drainage of a town or district; to the third, the epidemic diseases, as plague, cholera, or the exanthemata. But, although disease may be thus divided into three great classes, according to the immediate cause from which it springs,—and it may be said to be sporadic, endemic, or epidemic,—it must not be supposed, that these great immediate causes of disease are independent of one another, or that they may not act in combination, and by so much intensify the resulting disease. Thus: the man of intemperate habits, with disease already existing in some one of his organs, or so much disordered action as to constitute its initiative, will be more liable to suffer from causes that affect the health of the community of which he is a member, than he would be were he in perfect and vigorous health; and when so suffering, be more

likely to die, or to have his health permanently injured, or his life shortened, by such endemic disease, than a man who might be attacked when in health. And, moreover, the more largely acting causes of epidemic disease would influence more extensively and seriously a community already suffering from endemic disease, than a community not so suffering.

In a thinly peopled and imperfectly cultivated country, with large districts of undrained morass, the means of health may be in a great degree beyond individual attainment; and if to such causes, a variable, and on the whole extreme climate, whether tropical or frigid, be added, the individual life may be necessarily shorter than the average duration of the life of man, and the organization either stunted or feeble, and the mental and physical capabilities below par. In such a district, these may be the consequences, although the individual habits be necessarily temperate, and the life one of active, and by no means undue exertion. It should be remembered that these, the endemic causes of disease, are more destructive to health and life than individual irregularities,—that these causes, which are beyond individual control, and are only to be modified or removed by the combined efforts of an extensive society or body of men, may render life short, and the race feeble and sickly, in defiance of individual habits,—and that, on the other hand, the removal of the endemic causes of disease, or their extensive mitigation, may add to the duration of life, and the healthiness and vigour of the

race, despite the irregularities, privations, or excesses of the individuals. We find, in fact, these very circumstances in full operation in England at the present time. We find that the improved cultivation of the soil, its drainage, &c., is every year adding to the expectation of life in all classes of the people; and this, notwithstanding the denser population of the larger towns, and the still neglected ventilation, and the imperfect cleansing, of the districts inhabited by these densely packed masses; and notwithstanding the many causes which add to the individual sufferings and privations, or excesses; and notwithstanding the consequent increase of scrofulous predisposition, amongst the more exposed and the poorest of the population. Ague, with all its enormous amount of fatality, sooner or later victimising its thousands, has virtually disappeared even from the once fenny districts of the midland counties; fever is comparatively little known, unless in the closely peopled, badly drained, and badly ventilated districts of the larger towns,—among the ill-fed, the over-worked, and probably for the most part intemperate,—the poorest and most physically wretched of the population; and, even in this case, there is no doubt that it is rather the endemic than the individual causes of disease—the imperfect ventilation, the defective sewerage, and such causes as shew a neglect of public sanatory regulation and civic control, that lead to such disease, than the individual misery, or privation, or over-work, or excesses, that form its predisposing causes. And the existence of

such endemic causes of disease seems almost necessary, to render the epidemic causes as fatal as they are susceptible of being. Even the exanthemata—small-pox, &c.—appear to be robbed of half their terrors, when not exacerbated by such endemic influences; and without lessening, in any degree, the highest estimate of Jenner's magnificent and triumphant discovery of the true antidote to this particular horror, it seems that even small-pox might be robbed of many of its terrors as an epidemic, by sanatory fiscal regulations—by ventilation, perfect sewerage, and in fact, a pure air, untainted by living animals, or by effete animal substances, or decaying vegetable matters, or stagnant and necessarily tainted waters. Attention to the endemic causes of disease, and their careful removal, are said to have driven, or almost driven, the Plague from Egypt, where it has so long and so triumphantly dwelt, and which it has at intervals so extensively ravaged; and, at all events, to a great diminution of these causes has England been indebted for her long freedom from this gigantic disease; and to the endemic condition in which the Asiatic cholera found our towns, are we to ascribe its very various influence and ratio of mortality in different places,—and the comparatively small extent to which it affected the general mortality of the population,—and the shortness of the nevertheless severe visitation.

A pure air is not then attainable, without the toils and skill of the many being directed to the cultivation and drainage of the country at large;

and an old country, so cultivated and so drained, is unquestionably more healthy, *cæteris paribus,* than a country upon which less of these great changes have been wrought. The expectation of life in England becomes yearly greater; although its population increases so fast; although individual misery may increase in even greater proportion than the increase of the population; although the work-shops, the work-rooms, the mines, &c., may all tell fearful tales of victimised health and blighted life; although the very church-yards, reeking with decaying dead, in the midst of closely packed and fully inhabited dwellings, may well become sources of disease and mortality; although streets are still built far too narrow for such currents of air to pass through them as are necessary to health; although courts and alleys are so many cul-de-sacs, where free ventilation cannot be hoped for; although whole districts of towns are so badly sewered, as to make a healthy existence almost hopeless to their inhabitants. The expectation of life in America is becoming greater, and its population more vigorous and healthy, in the same ratio as its surface is becoming more extensively inhabited, its soil more thoroughly drained, and its air cleared of the impurities that exhale from a wet and corrupt surface-soil, charged with organic remains, which are exposed, and not immediately wanted by the existing vegetation. It thus happens that the climate of a newly peopled country, hitherto in a great degree covered with wood, or rankly grassed prairie, or undrained and in a great degree

submerged morass, becomes, in the first instance, so much less healthy, as the forest land is cleared, the morasses partially drained, and all the miasmatous exhalations multiplied; becomes less healthy in the same proportion as the woodland is robbed of its trees, and dense brushwood and grasses,—and the morasses are less entirely covered with water; and the miasms are rendered by so much more hurtful to animal existence, and by consequence to the health of man, as they are less changed and purified by the agency of a redundant vegetable life. Thus, the land may have been originally by no means, or to no great extent, injurious to the health of its few and widely scattered savage population; and yet speedily become greatly prejudicial to the health of its first civilised settlers, who clear its forests, and begin to cultivate its soil. This, however, will soon cease to be the case, as its surface gets to be better drained, as the land is brought more under tillage and under grass crops; and the probability will be, that, from having been at first so greatly deteriorated as a place of human residence, it will become eventually more healthy, and have a longer lived population, than when it was an uncultivated hunting-ground for barbarous denizens. The medical history of different districts of America have proved, and indeed are now proving, the truth of these statements.

It seems that, with fair play,—with a drained soil, covered with sufficient and not redundant crops; and consequently, with an atmosphere free, to a certain extent, from miasmatous exhalations,—human

life may be accommodated to almost every extreme and variety of climate; although probably several generations may be necessary to perfect the adaptation, and make the race of its inhabitants as healthy and as long lived as they are capable of becoming. This adaptation to different climates may be influenced by many causes; among the rest even by the colour of the skin, which, after the residence of successive generations in a particular climate, is now known and admitted to become more or less deeply tinged; varying more or less from the standard of black or white or brown, whichever may be believed to be the standard of perfection, or to have been the original colour of the human race. It is by no means, however, only by the colour of the skin, but likewise by the relative amount of work performed by all the different organs of the body, that this adaptation to different climates must be supposed to be effected. As in our own variable climate, the skin acts more freely in warm weather, and in the summer time, and the kidneys more freely under opposite circumstances, so must the amount, and what is the just balance of functions, be different in different climates; and such a habit of system may well be supposed to be by no means perfected during the life of an individual born of parents differently circumstanced; and as possibly requiring, and in extreme cases necessarily requiring, several generations to complete and establish the peculiar habit of body that is best adapted to any given region of the earth. It might indeed be contended, with much

probability, that, under the most favourable circumstances as regards soil and purity of atmosphere, human life is almost uniform in its duration, in all the climates of the earth; that three-score years and ten is the just duration of the life of man, whether inhabiting tropical, temperate, or frigid climes; and that the evident and unquestionable inequality in this respect in so many instances, is not owing to the climate, but to secondary and removable circumstances—to miasms and the like. It is indeed true, that the remittent fever of tropical countries, so directly resulting from the miasmatous exhalations of its undrained and corrupt soil, is, under any circumstances, and when attacking even the native population, a much more immediately and directly fatal complaint, than the intermittent fever which results from the same causes in temperate climates, which, if fatal, usually proves so only after many attacks, or by leading to some secondary, and eventually perhaps independent disease. But this would not militate against the argument, that all climates may, by drainage and cultivation, be made equally suitable and sanatory to the human race; whilst it will help to explain the great difference there is between the healthiness of different districts, countries, and climates, according to the degree in which the unfavourable circumstances obtain.

If to the causes of endemic diseases already spoken of, there be added exhalations from putrid animal substances, still more serious and fatal forms of disease are produced; and fever ceases to be either

intermittent or remittent, becoming continued, and typhoid, with increased and increasing tendency to a general putrescence of the affected organism; and, under certain circumstances, new and violent kinds of disease are produced, such as plague or cholera; and these, under circumstances or conditions of condensed virulence in the causes or concomitants,—by imperfect ventilation, for instance,—are generally admitted to acquire the additional property of being capable of communication directly from the sick to the healthy,—of being propagated by contagion or by infection. If not so concentrated, it may be said probably, that even these severer forms of endemic disease are not capable of being thus communicated, or of being rendered epidemic; unless it may be to systems prepared for their reception by pre-existing derangement of function, and in whom there may have been more or less of exposure to the original sources of disease. This latter circumstance throws great, and perhaps insurmountable, difficulties in the way of determining how far disease is capable of becoming contagious or infectious; making it doubtful, whether, in the cases where the probability of so direct an origin seems in the first instance to be the most strong, the individual cases may not really have originated from the same causes as originally gave rise to the disease. Nevertheless, it seems impossible to deny that, in some few instances,—they may perhaps be admitted to be the more rare and exceptional cases,—such diseases are traceable to a contagious or infectious origin, or at least that their

occurrence is not to be otherwise explained. Such an illustration as the following, is of frequent occurrence in fever hospitals. The majority of the patients are found to be derived, in a given year, from certain districts, and indeed from certain streets, of the town; and not only so, but probably, year after year, from the same districts and the same streets, unless some important physical change has been wrought in their condition, by improvements in the sewerage, and the like. Yet persons living at a part of the town remote from this, the fever district, who attend the wards of the hospital, and come into contact with, or even stand very near to, the persons of the affected, are often found to become seized with the fever; the complaint being shown to be the same disease, by having the same character, the same symptoms predominant, and even the same probable fatality, as the disease from which it seemed to originate, although placed in the first instance under such different circumstances, as a spacious and well ventilated room, surrounded by cleanliness and comfort, compared with the small, close, dirty and wretched apartment, from which the poorer victim of the disease was conveyed to the hospital. Medical students, the medical officers, the nurses, &c., of such institutions, afford too often, such vivid, and alas! occasionally such fatal illustrations of the possibility of the contagious or infectious propagation of such diseases, under the circumstances of concentration of its exhalations, whether from an isolated case of an aggravated character, or from several such cases occupying the

same apartment, or from imperfect ventilation of the wards—a degree of ventilation possibly sufficient for persons in health to maintain them in health, but insufficient to carry off the specific poison of the existing disease, or so to dilute it with pure and unvitiated air as to render it innocuous. Should, however, even such cases as these that have been cited admit, in the opinion of some, of another explanation, there can be little doubt that the degree to which the original causes of the disease are concentrated increases its severity, or, in other words, its malignant, putrescent and fatal character; or, that a continued exposure to the operation of the same causes after the seizure, adds to the probability of its being of severe and fatal character. This becomes, of course, one of the strongest arguments in favour of fever hospitals, and the best reason why such buildings,—while they should not be placed at such an inconvenient distance from the affected districts as to render them in any degree difficult of access,—should be far enough removed from the primary sources of disease, to be beyond suspicion of being subjected to the same malignant influences. Yet, after all, if the premises advanced be sound and tenable, it must be admitted that fever hospitals are, in themselves, public demonstrations of a neglect of those means by which the disease might be in a great degree, if not altogether, put an end to. It is to be borne in mind, that whereas an endemic fever of remittent or intermittent character may degenerate into the continued and

typhoid, or putrid type, by the addition of animal putrescence to the causes of atmospheric vitiation, the latter alone, if aided by moisture, may give rise to the same disease, although probably affecting a much more limited district; and hence typhus may be limited to a street, or almost to a house; or it may affect and ravage a wide district; and, in the same way, plague may be confined to one quarter of a town, or to several towns of a district, leaving untouched the population of some intermediate town, where the endemic causes are carefully removed, or from natural circumstances do not obtain.

But it must not be supposed that fevers, strictly so called, or even that forms of disease involving much constitutional excitement, are the only ailments that may be propagated from the sick to the healthy. Erysipelas, as has been too fully proved, is likewise thus communicable from the affected to the healthy by infection; and especially to such as are feeble, or who have some open wound of the surface, whether from accidental injury or consequent on a capital operation. This has been too frequently observed in the wards of hospitals, to admit of any dispute. It seems to have been proved, moreover, that the infection of erysipelas may, under some circumstances, be conveyed from the sick, by means of a third person, who remains unaffected with the disease, to parturient women, or women who have been recently delivered, producing that extreme form of disordered action, puerperal fever, which involves irritation of the lymphatics, probable inflammation

of the womb, the possible extension of the inflammatory action to the peritoneum, and great and perhaps fatal depression of the nervous energies. It is not even to be supposed that disease must be of acute character, in order to its being directly communicable. Itch affords a well-known illustration, that a disease may be of sufficiently chronic character, and of long standing, and by no means dangerous to life, and yet be readily communicable by contact of the affected with the healthy. Some diseases seem to be neither endemic, nor epidemic, nor strictly speaking sporadic, but to be only communicable by inoculation of the healthy from the affected: that is, by bringing the morbid secretions produced by the disease, and which are its specific result, into contact with the mucous membranes of the healthy, or with some other of their tissues that presents open-mouthed lymphatics for the absorption of the virus. Glanders and hydrophobia are examples of this peculiarity.

Whatever be the conclusions respecting the questions of contagion and infection, as direct sources of typhus or of remittent fever, or of the plague, or of cholera, or of any disease that may spring from an endemic cause, there is no doubt that an important class of diseases is thus propagated, whatever may be the source from which these diseases are originally derived. All the exanthemata—small-pox, measles, scarlatina, hooping-cough—are thus directly propagated, both by contagion and infection, perhaps especially by the latter; and require the air to be very

largely diluted before it ceases to have the infectious property; although the certainty and probability of its power is necessarily diminished or increased, as the exhalations from the affected person are more or less diluted. Not only so; but it would appear that the power of propagating these diseases continues for some time, even after the apparently perfect convalescence; and that some weeks must elapse between the entire subsidence of the attack and the perfect freedom from risk with which the healthy may be exposed to intercourse with the recently affected. It is a curious fact, that while this class of diseases constitutes the most extreme type of diseases—the type which is communicated as only the most aggravated and severe of the other forms of disease can be communicated, supposing that thus much were conceded,—it likewise constitutes the most perfect type of disease in its course, having a definite number of days for its progress, maturation and decline, being limited and defined in its course and duration. The same law of time or periodicity, applies, although much less strictly, to most forms of continued fever, whether typhoid or simple fever, which have likewise a marked tendency to run through a course of not less than a given length of time; often evidencing, moreover, a decided tendency to exacerbation or remission on particular days; and frequently making a curative or restorative effort, whether successfully or not, on certain days,—some one of which usually constitutes the crisis of the attack, whether this be the first, or the second,

or the third, or some subsequent one, of such marked and critical days,—so marked by the extended observation of a very large number of cases of the disease. This periodicity of disease is more noticeable in the case of remittent, and more noticeable still in that of intermittent fevers; and it is evidenced, although much more obscurely and uncertainly, in most febrile and inflammatory complaints, in which some days are marked by exacerbation of the complaint, some by its remission, —or some hours of the day or night are similarly distinguished.

Periodicity is, however, only one feature of disease: in some cases an important, in others a very insignificant feature of morbid action; which is often wholly absent; which is only another shape of that great natural law, which determines the hours of sleep and of wakefulness, of meal-times, and the like,—which helps man by adding to the number of his habits—habits, that when established, become almost instincts. And this law of periodicity, which, as applied to disease, is so often wanting, and is of primary importance in so few diseases, comparatively speaking, must not, as has been done at different times, be confounded with the essentials of disease, or considered to constitute one of its primary and necessary conditions.

All the many degrees there may be between the mildest case of intermittent fever and the most severe case of yellow fever,—from simple continued fever to typhus gravior,—are so many instances of

disease depending on endemie eauses, which vitiate the atmosphere, and eharge it more or less with noxious miasmata; and these may or may not be added to the less apparent primary eauses of epidemie diseases, as small-pox,—adding to their intensity; or they would seem, even *per se*, if concentrated in extreme, to have the power of rendering diseases that are usually simply endemic, epidemic, —or propagable directly from the sick to the healthy.

On all these forms of disease, civilisation,—the drainage and cultivation of the soil,—adequate sewerage,—commodiously eonstructed and well ventilated streets, houses, and apartments,—have exercised, and may exercise, so large an influenee, as to mitigate, or possibly altogether do away with, endemic disease; and to modify and greatly lessen the fatality of epidemic disease. These are the social gains aecruing to every individual of a well-organised community, the degree of which can scarcely be estimated; and which, however imperfectly and crudely conceived, might well reconcile us to the times we live in, and atone to us for not having lived in "those good old days," when agues, malignant fever, plague, putrid sore-throat, and confluent small-pox, thinned, at short intervals, the population of the towns, villages and hamlets of Old England. Civilisation, however, with all its great improvements, and the large boons it has conferred on the mass of the people, has dealt less mercifully with individuals. Shutting up so many in the elose and

less pure air of our large cities, and such numbers in the closer air of workshops, cellars, and small rooms,—confining so many to a single occupation, involving perhaps almost a single position of the body, day by day, and year by year,—making life a succession of privations, confinement, and mechanical and unvarying employment,—civilisation deals out to these her victims, a large amount of individual disease and suffering, which never reach the social importance of endemic or epidemic disease, but which sicken the life and shorten it, and affect injuriously the health and the probability of life of the posterity,—probably to destroy the individual and his descendants in the course of a few suffering generations, by forms of disease characterised in all their phases by diminished power, and called cachectic, having the generic name of scrofula common to the whole of them. And yet there is no doubt that much of this individual penalty, which is paid by social man for his civilised position, is no necessary part of the civilised state,—that, although large numbers of people cannot be brought together into one building, where they must spend a large part of every twenty-four hours, without some degree of physical injury to them all,—that, although individual health must be affected even by the crowding of large masses of people into the limited district of a closely built town,—yet, by sewerage, by cleanliness, by ventilation, a great amount of the evil may be done away with, and the expectation of life, although not equal to the highest standard attain-

able in a well-drained rural district, be greatly increased from that which obtains under less favouring circumstances.

Following health and disease downwards from the classes to the individuals, we find many things attending the state of high and advancing civilisation, that are both for and against the healthiness and the expectation of life. The price of food probably rises, in some degree, in proportion to the increasing population and the greater demand, and in a greater proportion than the relative advancement of the wages of the handicraft or mere labourer; and hence the further evil of insufficient, or a lower character of food, is risked in the case of the producing classes of the people: animal food from its greater relative cost becomes less and less attainable, and vegetable food becomes more and more exclusively the means of support. To counterbalance this risk in some degree, an advancing agriculture gives them a variety of vegetable productions unknown to their ancestors, or less generally enjoyed by them, the effect of which is not only to multiply the physical enjoyments, but to promote the health, and add to the expectation of life. It needs only to mention the potato and almost all the pot-herbs, in proof of the change in these respects in the daily fare of the poorest of the population; and the whiter and much better bread is further proof of the same fact. Commerce, too, extending itself to all parts of the world, and bringing tea, coffee, spices, &c., to temper his system to its altered habits, from those of severe

out-of-door labour to sedentary in-door employment, has helped, and greatly helped, to diminish the social evils that must attend upon the march of civilisation. And then, manufactures,—while they draw an immense proportion of the people from the fields into the towns, and expose them to the sufferings consequent on breathing all their lives the more or less vitiated atmosphere,—in their turn supply all classes of the people with better, and warmer, and more various and suitable clothing, and at a far cheaper rate, to protect the surface, maintain the bodily temperature, and so diminish or cut off the sources of a large number of the more important and dangerous forms of disease.

To whatever degree, then, it may be admitted that the health of social mankind is benefited by civilisation,—however far the expectation of life is increased by the diminished chances of epidemic and endemic diseases, and the mitigated severity of such diseases when they do occur,—and however far the individual sufferings of a large number of the people, that are consequent upon a town life and in-door occupations, may be lessened by sanatory regulations and control, and by an increased general enlightenment of the minds of the suffering masses, to shew them how they themselves may aid in lessening these evils, which press on them so heavily,—a large amount of individual evil must still be left, as it were by way of penalty for so much good to the community at large, which no mere sanatory regulations can reach, but which are not there-

fore wholly without means of mitigation. Such means are to found in judicious self-control and self-culture,—in the careful avoidance of whatever may be injurious to the health,—in the care taken to modify, as far as possible, whatever may be the injurious tendencies of the social position,—in the judicious management of children during the important years of growth, lessening, as far as may be, any hereditary tendencies to disease that may have descended to them,—in careful attention to the means of promoting the development and the vigour of every faculty and function,—and in ever diminishing, by such means, the risk of an undue taxation for the many and admitted social advantages. Such seem to be, strictly speaking, the aim, scope, and importance of diet and regimen, to the consideration of which the foregoing observations may serve as a not unfitting introduction.

It is not, however, meant by this, that,—although the words diet and regimen appear to confine the subject to such hygienic questions as belong to the individual members of a community, and to be thus, either wholly or in a great degree, under their personal guidance and control,—such questions could be, in every case, thus exclusively treated, or that it would be advantageous, even were it possible, thus to consider them. The subjects of ventilation and climate could scarcely be reduced to questions of merely individual concern. On the contrary, to consider the circumstances and relations of these great means of health in a satisfactory manner, the purity of the air,

its hygrometrical charaeter, its tempcrature, its density (clevation), and its movemcnt (vcntilation), and the direetion of the prevailing winds, must be eonneeted with the geographical position of the plaee, and its geologieal eharaeter, and with its vcgctation, irrigation and drainage, in order to the filling up of the outline obtaincd by studying the lcss general eircumstanees of the position of the dwelling, the size and aspeet of the rooms, the nature of its surfaee-soil, and the modes of heating, lighting, and ventilating the interior of the building. Nor is it meant to be implied, that, in speaking of diet and regimen as ehiefly, or more strietly, individual questions, whieh every one may be supposed to be able to influence for the advantage or otherwise of his health, and his expceta-tion of life, that this is thcrefore a mattcr less strictly medieal than the other questions appertaining to the physieal interests of mankind. On the contrary, however useful definitc views and opinions may be to every member of a community, as to the rclative digestibility of the different articles of food, as to the uses of museular exercise and its modc of aetion and effeets on the system, as to the value of ventilation, the influence of elimate, &e., &c., the praetieal applieation of sueh knowlcdge, its definite reduction to cases and eireumstances, must be left to the judgment and experienee of thc medieal professiou, from whom the public arc cntitled to expcet so much guidancc, and who have, it may not be disputed, becn morc or less wanting in this great duty. To keep people well may often be a morc difficult mattcr than to restorc

them to health; and the art and capability of carrying the principles of Hygiene to every man's habitual life, and adapting them to every one's constitution and the wants of his position, are the strict and proper business of the medical man. The public may learn —and learn most advantageously to the chances of life, health, intellectual capability, and probability of usefulness—the general principles on which alcohol is believed to influence the animal economy, its effects on the system, the good and the evil that it may produce; but no man can judge for himself, or but few could be trusted to judge, as to whether he should, or should not, abstain altogether from the use of alcohol, in any form. Two men find themselves to be suffering from evident symptoms of determination of blood to the head; and both may be much on a par, as regards age, condition, occupation, and even habits of life; and yet the one require depletion, and the other tonics—the one be injured, and the other benefited, by the moderate use of stimulants. How needless to add, that this distinction, to draw which would be quite beyond the capabilities of either sufferer for himself, might be readily made, in a few seconds, by a medical man practised in the use of the stethoscope. Nothing is more true, and to some extent nothing can be more useful knowledge, than that temperance in the use of the alcoholic compounds conduces to health and all the best physical blessings of life; but nothing is better proved, than that temperance to one man means literal abstinence from all such potations, and

that every indulgence in their use, to however small a degree, is injurious to his bodily well-being, and therefore a virtual intemperance; and nothing is more fully proved, than that, in these latitudes, there is a large number of people, in whom, either from hereditary delicacy of constitution, or from the nature of the employment, or from the kind of district they inhabit, a certain quantity of alcohol, in some form or other, mixed with the food, is decidedly useful, diminishing the risk of disease, promoting the strength of the system, and, in all likelihood, prolonging the existence. In circumstances of disordered condition of the physique, it is still more plain, that every decision as to the use of stimulants, or as to the nature of the aliment to be used, can only be given judiciously by the medical man; and demands from him as nice and careful observation, analysis, and comparison of the facts of the case before him, as the prescription, to write which is the more ostensible part of his duty. If medical men were to feel the importance and needfulness of doing their whole duty as to these great questions, and to become the dispensers of hygienic lessons and dietetic orders as well as of drugs, and in this path to go beyond the more immediately urgent duty of enjoining the antiphlogistic regimen in acute cases, the gross errors in questions of hygiene on the part of the public, and the general ignorance as to the importance and value of attention to the organic laws and the subsidiary means of health, must soon disappear. Were medical men

to assume the position, which their information, experience and social station, alone enable them, of all mankind, to occupy,—and to make the subjects of diet and regimen matters of daily and hourly teaching to those, for whose physical well-being they are so largely responsible,—intra-mural sepulture, defective sewerage, cellar-habitations, and a long list of similarly gross violations of the organic laws, could never continue to find a place among any people removed from barbarism. If the proved and admitted facts on these subjects were known to all men, would the offensive, the health-damaging, and life-deteriorating custom of packing the dead, side by side, and tier above tier, in the churchyards, in the midst of closely-placed and fully-peopled dwellings, be allowed to continue? The people in general do not, and cannot know, that the occurrence of a case of fever, not obviously dependent on some localised inflammation of adequate severity, is *primâ facie* proof that there is in the district some removable source of atmospherical impurity, which,—although possibly producing only one case of fever, or only a few cases of fever,—and although perhaps attracting little notice, and not affecting under the name of fever the tables of mortality, or even adding directly to the local rates under the guise of widowhood or orphanage,—gives rise, necessarily, to numberless cases of lesser disease, amounting to fever only in those who have been predisposed to suffer largely from the operation of such causes, owing to debility or functional derangement however induced, or in

those who have been most exposed to the miasmatous matter, which has so far poisoned the air. Such minor disordered conditions may be visceral derangement, dyspepsia, irregularities of the circulation, or any of the countless forms of *malaise*, that render man less fitted for the duties of his calling, if not temporarily incapacitated from following it at all. People do not and cannot know such facts as these; or nothing less than a hue and cry would be raised on the occurrence of fever; the sources of impurity would be anxiously investigated; and every matter for suspicion would be promptly and carefully removed. It cannot be believed, that the public mind is aroused to the vast and vital consequences of ignorance and inattention to these questions; and it is only to the members of the medical profession, that attention can be turned with any hope of witnessing speedily a more enlightened state of things.

There is another question to which I would allude, before concluding this necessarily somewhat discursive introduction. It is a question that is intimately bound up with the well-being of the people, and which is essentially dependent on the personal efforts made by medical men, to extend to the masses of the population, some general information as to the principles and reasonings, the facts and deductions, on which the art and practice of medicine are founded and built. This is no less than the suppression of quackery in the treatment of the diseases of mankind, or at least its gradual removal: an end, perhaps, only to be attained, or even approached, by these means.

It would probably signify but little, even if the Legislature were to resign its greater or less profits on the sale of quack medicines, and no longer invest them with the legal stamp, which gives them a sort of national sanction. It might not, perhaps, have any very great influence, even if our universities and colleges were to make a decided stand against empiricism in all its shapes, and signalise the determination by expelling from their numbers, every member of the profession, proved to have lent himself to any of the humbugs that delude mankind,—consigning those who practise, and those who aid and abet the practice, of any of the forms of Charlatanism, to a notable dismissal from our ranks. It might signify but little, if the Legislature were even to forbid the sale of unprescribed medicines,—to place the health of the people at large in the care of public and fully qualified medical officers,—and ascertain duly the fitness of every one practising the profession in the cases of individual disease,—visiting every one found guilty of practising without such qualification, with an amount of punishment proportionate to the degree of the misdemeanour. All such means, admitting that they are steps in the right direction, and such as a well-informed Legislature might be justified in adopting, and the protection of the public from the wrong inflicted by the ignorant or the knavish might appear to demand, are liable to be regarded as an unfair and uncalled-for interference with the liberty of the people, until the public mind is so fully informed of the expediency

of such measures, so fully alive to the irrationality and knavishness of quackery, in all its shapes, as, in fact, to require no protection from its machinations, unless in the case of the lowest and least informed remnant of the people, over whom a paternal Legislature might feel the kindness and necessity of throwing the shield of its enactments, as a safeguard against the efforts of the designing and unprincipled. I would not have myself so far misunderstood, as to be thought capable of undervaluing whatever efforts may have been made to suppress quackery, whether by bringing about the exposure and disgrace of those who practise it, or by enlisting in so good a cause the strong arm of the State. Quackery, in all its shapes, is only second in amount of bad consequences to those of the general ignorance which has indirectly served to maintain epidemic and endemic disease in these latitudes, and thereby to augment so much the ratio of mortality, and the amount of widowhood and orphanage, of these kingdoms; and whatever tends to lessen either the ignorance on the one hand, or the advantage taken of the ignorant by the quack on the other, are necessarily only different paths leading to the same object.

CHAPTER II.

On Diet.—Digestion.—Complicated Nature of the Assimilating Processes.—Chemical Opinions.—Animal Food more easily assimilated than Vegetable Food.—Circumstances influencing the Kind and Amount of Food required.—Digestion a Vital Action.—Influence of the Nervous System on Assimilation.—Influence of Digestion on the Circulation, and the general Economy of the Body.—Indigestion a predisposing and exciting Cause of Disease.—Importance of Dietetics.—Nature's Dietetics.—Chemical Constitution of the Body.—Non-azotised, Albuminous, and Gelatinous Tissues.—Fibrin, Albumen, and Casein of Alimentary Substances convertible into Protein.—Use of the Non-azotised Aliments.—Use of the Gelatinous Aliments.—Experiments on the Comparative Digestibility of the Articles of Food.—Dr. Beaumont's Case of Alexis St. Martin; its Results and Inferences.—Dietetic Tables of Comparative Digestibility.—Comparative Digestibility of Animal Substances.—Meats.—Poultry.—Game.—Gravy.—Gelatin.—Fibrin.—Fat.—Turtle.—Fish.—Milk and its Products.—Egg.—Comparative Digestibility of Vegetable Substances.—Grain: Wheat, Oats, Rye, Barley, Maize, Rice, &c.—Pot-herbs, Roots, &c.—Vegetables eaten Uncooked.—Fruits and Seeds.—Dried Fruits.—Vegetable Principles: Starch, Gum, Sugar, Oil.—Effect of Saliva on Digestion of Fecula.—Crystallisable Substances.—Molasses, Honey.—Condiments.—Spices.—Tea, Coffee, Cocoa.—Liquors the product of Fermentation.—Dietetic Effect of Water.—General Dietetic Rules.—Quantity of Food required.—Meal-times, &c.

To regulate the diet, is the first and most important step that can be taken, either to restore health or to preserve it. The great series of processes concerned in the nutrition of the body,—the

minute mechanical division of the food by mastication,—its intimate mixture with the saliva—with the probable effect of still further separating it into detached particles, of adding to it a chemical reagent, and of mixing with it a large amount of atmospheric air, for taking up and enclosing which within it, in considerable quantity, the saliva is so peculiarly remarkable, — the giving to the mass, when it has reached the stomach, the temperature of the body,—the adding to it a peculiar solvent, the gastric juice, which is likewise largely antiseptic, —the solution of the solid parts of the food, and the conversion of the contents of the stomach into a homogeneous mass of pulpy consistence, the whole being thus mixed with the gastric juice, and blended into an uniform mass, by the vermicular contractions of the coats of the stomach, — the mechanical ejection of the chymous mass from the stomach, by means of the contractions of the viscus, — the mixture of the chyme with the bile in the duodenum, and the consequent neutralisation of the excess of acid, saponification of the oily matters, and large addition of carbon to the whole of the alimentary mass,—the extraction, by the vital and mechanical powers of the lymphatics, of the nutrimentary from the excrementitious matters, — the conveyance of the chyle thus formed, into the thoracic duct, and thence into the current of the circulation of the blood, where, soon passing through the lungs, it loses much of its watery particles, becomes oxygenated, and is formed into perfect and

vitalised blood, fitted for the restoration of the wasted, and the repair of the worn-out parts of the different organs and tissues of the body,—are all parts of the great function of digestion, all subject to derangement from many causes, and when so deranged, are with difficulty, if at all restorable to a healthy state, unless the character and circumstances of the food that is taken, be accommodated to the deranged condition of the system it is intended to nourish. Such disordered state of the digestive functions, moreover, interferes largely with the general power and economy of the system, renders it less fitted to resist and overcome external influences that are calculated to affect it injuriously, and thus may form the remote cause of many, and a directly-exciting cause of some, of the diseases to which man is liable. It is in this direct and this indirect way, that the state of the digestive organs assumes such an important position in the great questions of maintaining health and warding off disease, or of restoring health when it is deranged; and it is thus that dietetic facts and observations acquire an increased importance, both with reference to health and disease.

I venture to retain this account of the functions of the stomach in regard to digestion, notwithstanding the more recent views regarding the action of a disintegrant and fermenting product, itself in a state of molecular movement and undergoing the process of decomposition and change, which is believed to be derived from the effete matters thrown off from the lining membrane of the stomach, or to be formed

of detached portions of its own expended organism, —and, acting exactly on the principle of yeast or ferment, is supposed to throw into movement and produce the re-arrangement of the molecules of the food, and accomplish the first of the series of changes in it that have to be undergone before it can again become a part of a living organism. To this should be added the opinions, that, in this case, the acid secretion of the stomach may be either unnecessary, —only the product of irritation—offering, whenever present, *primâ facie* evidence of a disordered condition,—or, in another view, may be always present, but only serves to disintegrate the food, and diminish the cohesion of its particles, before it is subjected to the action of the ferment,—or, by the known antiseptic action of organic acids, this secretion may be of importance, after the food has undergone those molecular changes, in arresting the fermentative process, and arresting it at such a point, as to ensure that the molecular condition of the food, when it leaves the stomach to undergo the next stage in the process of digestion, should be always the same, and precisely that which is best suited to the action of the other assimilating agents, and the chemical constitution of the organism of which it is to form a part. Having thus early set forth these statements and views, as to the action of the stomach on the food, and the changes which the aliment undergoes in the stomach: views which forcibly recal to mind the passage quoted by Dr. Paris, from a MS. note of one of John

Hunter's lectures,—"Some say the stomach is a laboratory, others that it is a fermenting vat, others that it is a stew-pan, but I say that it is a stomach, gentlemen, a stomach;"—having stated these views, and admitted most fully their ingenuity, their interesting character, their plausibility, and allowed that they may eventually be shown to be true;—granting that they are supported by much analogy,—that the process of fermentation, with the molecular changes, and altered relations, composition and character produced by it, is at least curiously similar to those alterations produced in alimentary substances in the processes of digestion;—it must be added, that it is only a theory, that it is not yet an established doctrine, and that the comparatively small importance it leaves to the acid secretion of the stomach must, until more is ascertained, tend to add to the reasonable doubts entertained in regard to it. It may be added, that much and undeniable evidence would have to be afforded, before the opinion that the acid secretion of the stomach is only a morbid product, and is not necessary to the purposes of digestion, could possibly be believed. Under these circumstances, it is perhaps justifiable to retain the older mode of explaining the action of the stomach on the food, if to this be added the probable action of some cause of molecular movement, similar to that which might be caused by a ferment, by which the series of intestine movements of those molecules is commenced, which must be accomplished before the various aliments can be re-organised, and

converted into a fluid which is to all seeming exactly the same, whether the aliment be vegetable or animal, and the same no matter what the character of the vegetable or animal food, provided only that it contains the four elementary substances, that are essential to the composition of every living creature.

The experiments instituted by Dr. Beaumont in the case of Alexis St. Martin, hereafter detailed (page 65), confirm if they do not prove the primary importance of the gastric juice in the solution of the aliments within the stomach. It by no means follows, however, that the action of the gastric juice upon the aliments should be exclusively, or even chiefly, by virtue of the acid or acids it is in part composed of. On the contrary, it seems to be proved that food is not dissolved in diluted acids, unless a small proportion of the animal matter secreted from the lining membrane of the stomach, is mixed with the acids. It appears to be a justifiable inference from these experiments, which have been performed over and over again by different chemists and in different ways, that this animal matter performs no secondary part in the formation of the chyme; and it seems to be a probable inference that its action is somewhat analogous to that of a ferment, and that it produces the molecular changes in the ultimate particles of the food, which must attend the great changes it undergoes in its conversion into chyme, and be needful to prepare it for being again brought within the influence of the vital principle, and rendered fit to form part of the living organism. To the

animal matter which exercises this great effect in the digestive process,—which is probably itself in a state of molecular movement, and therefore capable of communicating such movement to other organised substances,—and which, from all analogy, is perhaps justifiably believed to be peculiar in its composition and character,—the name of pepsin has been given. The nature of the acid contained in the gastric juice has occupied the attention of most of the great chemists; and it has been said to be hydrochloric acid, acetic acid, lactic acid, superphosphate of lime, &c. A much more practically interesting result derived from the numerous and anxious investigations into these questions, and one that seems to be proved, is, that an animal matter contained in the saliva, and separable from it, when mixed with alkali proves to be the solvent and digestive medium of starch, upon which acidulated animal matter has no action,—and that either this same animal matter, or some similarly constituted animal matter, when mixed with the acid secretion of the stomach, proves to be the proper solvent for the azotised articles of food, such as fibrin, gelatin and albumen, having no power to dissolve or assimilate the non-azotised aliments.

It should however be added, that in the views entertained by chemists as to the theory of the assimilating processes, there is perhaps too little allowance made for the influence of the vital principle—the organising agent. In all the views, reasonings and inferences, which greater researches and further information may seem to justify, the true vital character of the

digestive functions must be always set forth, or truth and usefulness must be equally forfeited.

It is by no means the case, that all alimentary substances are digested and assimilated with equal facility, by the chemical and vital powers of the system, any more than it is the case that all such substances are equally nourishing. On the contrary, the nearer the food is, in the first instance, to the composition of the blood, the more easily is it assimilated; and hence, other things being equal, animal food is so much more easily digested and assimilated than vegetable food; and hence, the great anatomical fact finds its explanation,—that the digestive organs are so much more complicated in the herbivorous than in the carnivorous animals. In man, the same thing is illustrated, both in health and disease. In infancy, all attempts to nourish the system on vegetable food exclusively, must signally fail, from the fact that the digestive organs are, at that time, unequal to the great task of converting matters into blood, that are so different to it in their composition, or in the arrangement or proportion of their elementary constituents;—in states of disease characterised by much debility, the system must be nourished, almost exclusively, on the more simple forms of animal food, and cannot otherwise be restored to health;—and, when in health, man must be in high vigour, and be placed in circumstances which greatly aid in maintaining the digestive organs in the fullest power, if he can be preserved in health and strength

on a strictly vegetable diet, *i.e.*, a diet not only without animal fibre, but without animal substance in any form constituting a part of it. It may indeed be necessary, and often must be so, that, even in states of disease, the system must be confined to a strictly vegetable diet; but this amounts, in such cases, to a comparative question of starvation, for the relief of such morbid action; and the vegetable food must be offered in such moderate quantity, and in so comparatively easily digested a form, as may accommodate it, as far as may be, to the general derangement, and to the assimilating capabilities of the organs of digestion. But it by no means follows that, because animal food is more easily digested than vegetable food by the healthy human stomach, it should therefore be more suited to the feeble or the disordered stomach. Under such circumstances, on the contrary, animal food may prove too directly stimulating to the stomach itself, or indirectly add to the morbid condition by stimulating too much the general system, and necessitate the use of a vegetable diet, or of a diet in great part vegetable, even admitting that it might be less easily digested than some forms of animal food; while the knowledge of the great fact, that vegetable food is comparatively less easily digested, might influence the kind and quality and form in which the vegetable food should be given, or lead to the mixing with it, as soon as circumstances might permit, and to as great a degree as might seem otherwise expedient, a larger or smaller proportion of

animal food. It does not follow however, that because food is more easily reduced to a chymous mass by the peptic and solvent powers of the stomach, it is therefore easily assimilated, and readily formed into blood; for the stomach's duties in the process of digestion, although of primary importance, are not all-exclusively important. Many articles of food which occasion no inconvenience to the stomach itself—leaving it speedily, in a state of unirritating chyme—may be so unsuited to the state of the other digestive organs as to lodge in the intestines, and eventually be expelled from them, in a but little if at all altered state, having failed altogether in the great purpose of nourishing the body. This is sometimes found to be the case, where farina, or starch, in any of its forms, has been too exclusively trusted to, as the diet of children, or of invalids. Some animal substances then, although confessedly more easily *assimilated* than vegetable substances, may be justifiably considered to be unsuitable food in certain cases, from their being less easily dissolved by the secretions of the stomach than certain vegetable substances, from their adding by so much to the unavoidable amount of the stomach's duties, which it may be important to render as little onerous as possible; or an animal diet may be objectionable in these or other cases, even where facility of assimilation is of considerable importance, from its proving too directly and largely nutrimentary, or too directly stimulating, to a morbid and irritable state of the system. The question of comparative

digestibility, or comparative facility of assimilation, may then, in some cases, become of secondary importance to that of the comparative nutritiousness, or the comparatively stimulating character of the articles of food. Again,—as will have to be more fully stated afterwards,—the form in which the article of food is offered to the action of the gastric juice, has very much to do with the readiness with which it may be assimilated. Liquids, when taken alone into the stomach, unmixed with solid food, are in a great degree absorbed by the veins and absorbents, which open on the lining membrane of the viscus, and thus escape, to that extent, the necessity of being subjected to the ordeal of the digestive processes. But liquids holding solid matters in solution are by no means always permitted to escape thus, but have to be digested,—a large proportion of the fluid part being however, when the stomach is healthy, drawn off from the solid matters, which are thus left in a state better adapted to the peptic powers of the gastric secretion. When the stomach is in a less healthy state, and its gastric juice has less of solvent power, and probably a more acrid character, and the absorbents perform their duty less perfectly, or possibly not at all, aliment taken in a semi-fluid state is often found to be with much difficulty converted into chyme, to remain a long time in the stomach, and perhaps to be rejected from it, charged with acrid morbid secretions from the stomach and its mucous membrane, when the same aliment,

taken in a more solid form, is digested without perceptible difficulty. On the other hand, food may present difficulties to the stomach and other organs of assimilation, which may be strictly called mechanical,—depending, in fact, on its being too hard and dense in its character and consistence; thus, over-cooked and dried meat becomes less easily digested, in direct proportion to its hardness and dryness. Some substances are more or less digestible, owing to their chemical constitution and character rendering them stimulating, or irritating, or causing them to neutralise and interfere with the chemical action of the gastric juice, or to aid and promote its solvent properties. The necessities of the system likewise, in some degree, influence the activity and power of the assimilating functions; but this with too many exceptions, to render the state of the digestive functions an infallible guide, as to the quantity or the kind of food that should be taken. The habits of the individual, and as it should appear, the habits of his parents, likewise influence and serve to modify the amount and the character of the food that the system requires. And the temporary state of muscular repose or activity, vigour or exhaustion,—of a mind engrossed by thought, or in a state of relaxation from toil,—through the medium of the nervous system, interferes with, or aids, the solvent powers of the stomach, and the influence of that and the other digestive organs in effecting the needful changes in the ingesta—re-arranging and vitalising the molecules of the food, and fitting them to

form a part of the living organism. Further, through the medium of the respiration, the requirements of the system for fresh supplies of nutrimentary matter may differ very much at different times, owing to a varying expenditure; and from this cause, the activity and power of the digestive functions may vary very perceptibly, and to an important degree, at different times. By expending a large amount of carbon, the respiration requires at all times an important proportion of the alimentary supplies; and when the consumption of carbon by the respiratory function is more considerable, as it necessarily is in cold weather, to maintain at its normal and elevated standard the temperature of the body, the alimentary supplies must likewise be more considerable, or the powers of the system must be drawn upon for the extra consumption; and usually, the digestive organs become proportionably more active, to meet this increased demand.

The peptic functions of the stomach require, for their performance, a large amount of vital or nervous power, and a considerable determination of blood to the organ, while engaged in its duties. Whatever interferes temporarily, or for any longer period of time, with either of these conditions, to the same extent deranges the functions of the organ, and induces dyspepsia. The physiology of digestion is thus very intimately connected with its pathology. The series of processes concerned in the assimilation of the food and its conversion into blood, peculiarly requires the *mens sana in corpore sano*. Exercise,

by determining the blood to the surface of the body, and by using the nervous powers specially in willing the action of the muscles concerned in the movements required, interferes by so much with the digestive functions; and, by consequence, the less vigorous the nervous and vascular systems, the more feeble the individual, or the less healthy the digestive powers, the greater this risk, and the more extreme the degree of the dyspepsia induced. Nervous exhaustion, however brought about, whether by disease, or by loss of sleep, or by excessive muscular exercise, or by the undue perspiration occasioned by very hot weather, or by the depressing passions and emotions of the mind, or by excessive care, anxiety, or study, to the same degree as it obtains, influences and deranges the digestive processes. Some such causes may last for a considerable time, and derange in an increasing degree the digestive powers; and even lead to organic change in the structure of the organs, and consequently to permanent injury of their functions. It is not only then, that the food varies much in the degree of its digestibility, but that the system varies much in its capability of assimilation; and it follows that there arise thus additional reasons, why the relative facility with which different articles of food are digested, should be as far as possible determined and known, in order to adapt the kind of food to the varying circumstances of every man's daily life, and to avoid as far as may be the risk of adding dyspepsia to the other trials and dangers of his existence.

A due balance of the powers of the nervous system is necessary to the just performance of all the different functions of the animal economy. A man arises in the morning, refreshed by sleep,—his nervous system restored to its tone, and its several and different endowments, for mental, organic, respiratory, sentient and motor acts, rendered once more equable in their relative degree, and apt for the discharge of their great duties. For, during every day of the most regular life, some one of the nervous faculties must almost necessarily be more used than the others, and by so much deprive the others of the nervous power that might have been expended upon them; the equipoise of nervous or vital power being restored by sleep. As a matter of course, the stomach and other organs of assimilation are by so much more capable of performing their duties rightly, and without inconvenience, as there is more of vital power ready to be expended upon them; and by so much is the first meal in the day the least likely to be followed by dyspeptic symptoms. There are indeed exceptions to this: exceptions caused by such morbid conditions as render the sleep unrefreshing, and incapable of restoring the due balance of the nervous energies; as when the nervous and vascular systems are so far deranged, whether primarily or secondarily, as to lead to local determinations of blood, to irritation or congestion, and to exhaustion or torpor. In some of these cases, the digestive powers in the morning are as feeble as at any other time of the

day; and in others, especially the congestive and the torpid states, the system, by the exercise of its several duties, mental and bodily, has the balance of the nervous power in some degree restored, which the sleep had only further deranged, — and the assimilating organs accordingly become more apt for their duty in the after-parts of the day, than in the early morning. Many cases of chronic disease, of great debility and nervous derangement, illustrate this; and a restored appetite for the breakfast, and an increased power of digesting it, become important indications of a return to health. On the other hand, in the early stages of many such chronic cases, a diminished digestive power in the morning is often one of the first and important indications of the evil at hand.

How entirely the due performance of the assimilating processes is dependent on the condition of the nervous and vascular systems, admits of sufficiently familiar illustration. A man sits down to his dinner, after severe or long-continued exercise, with his nervous energies expended, or much excited; the blood being probably determined unduly to the surface; and the action of the heart and arteries either already depressed, or, if rather irritated than depressed, yet having so little real vigour as to be ill-fitted to perform the extra duty of determining the blood adequately to the stomach, to render the first stage of digestion sufficiently short and perfect; and the nervous energies being already so far expended, as to leave little power for securing the due elimination of the gastric

juice, and the due performanee of the vital functions of the stomach: in such a state, even an ordinary meal of food may be most unwisely taken; and it could hardly be expeeted to be digestcd without difficulty and inconvenience. The praetical lesson might be dcdueed, that, under sueh circumstanees, there should be a longer or shorter interval of time between the exereise and the meal, in which the circulation may reeover its equilibrium, the aetion of the heart and arteries may regain its power, and the nervous energies be proportionably restored to their usual eondition. Supposing however, that this matter should not be understood, or should be neglected, and that the meal be taken under thcse cireumstances,—the additional effort required from the circulating organs, and from the vital powers, will probably add so far to their pre-existing disturbance, as to induce a disturbed or an oppressed sleep the conjoined effect of expcnded nervous encrgy and an irregularly-distributed circulation, during which state of comparative rest of mind and body, an additional effort is made to further the performanee of the duties of thc stomaeh, by eoncentrating upon it the undivided efforts of the nervous and vascular systems; the primary digestion bcing, nevertheless, in all likelihood performcd imperfcctly, if performed at all,—and the food bcing ejccted from the stomach into thc bowcls, in a erude and imperfectly ehymous statc. It is much the samc if the ncrvous or the vascular system be otherwise influenccd to the same cxtcnt, in any diffcrent way, by whieh its vigour, or

its devotedness to its special duty of ministering to the digestive function, is affected. Thus, mental exhaustion, expended as the nervous powers must be in this state, may in the same way interfere with the peptic duties of the stomach; and so, the mental emotions or passions, and anxiety, may immediately affect, in a greater or less degree, the function of digestion. And these same facts are equally applicable, if the exertion of mind or body,—if the mental emotion, or anxiety, or stretch of thought,—have to be undergone soon after a meal, as if they had preceded it. The stronger and voluntary effort overcomes the less active or less energetic involuntary function; and the hurried walk, or long ride,—the unhappy tidings, or sudden exertion, — may bring to a sudden stop the digestive process, or derange it so materially, as to involve a fit of indigestion as the necessary consequence, after the simplest and lightest meal, which would otherwise have been converted into chyme in a short time, and without the smallest apparent effect either on the pulse or the nervous powers. This might well teach the foolishness of forcing grief to its stated and usual meals,—of expecting the overworked student to maintain his ordinary appetite, and to continue, without dyspepsia, his previous diet, —of desiring that the watchful attendant on the bed of sickness, and especially when mind and body are being equally exhausted by protracted vigils, should eat more than may just suffice to support the enfeebled system, without adding indigestion to its unselfish

cares. In the same way—because, during digestion, so much of the nervous and vascular power is devoted to the stomach and its duties—exposure to cold and wet becomes so much more dangerous after a full meal than before it, for the self-evident reason that the resisting powers of the body, the efforts to maintain an active state of the surface-circulation, to provide for a large combustion of carbon to compensate for the unusually rapid loss of the temperature of the body, are now, in some degree, diverted from these great and pressing duties, to produce the solution and chymification of the food in the stomach. A common illustration of the effect of digestion in thus influencing the other great processes of the system, is found in the sense of coldness so commonly experienced after an unusually large meal, or when the food taken has been of difficult digestion, or when the air is at the lowest temperature which the system could previously resist without inconvenience. But it is not only the condition of the mind and the body, as influenced by their own acts, that affects the functions of the stomach. The temperature of the air likewise largely influences the expenditure of the food in the respiratory process, and to the same extent affects the powers by which the supply is proportioned to the demand. In warm weather, the system has to burn less carbon in order to maintain itself at the temperature of 98 degrees, and by so much is less of the food expended in this way, and diverted from its other office of repairing the wear and the waste of the body,—and by so much is less food

required, and the risk of repletion from the ordinary diet, and of indigestion from an over-loaded state of the circulation, increased. And in the same way, in cold weather, more food is required for the respiratory process, and more is abstracted from the blood for this purpose, and the necessity arises for additional supplies to maintain the system in its due vigour; and to subserve this purpose, the circulation, thus unloaded, or more efficiently drained of possible redundancies,—and the nervous system, thus left in a state of unfettered vigour,—are in an apt condition to further the consumption and digestion of additional nourishment. And hence is explained the now admitted, but at first somewhat startling fact, that the inadequately clothed, whose surfaces are comparatively ill-protected from the cold, whose systems are thus robbed of temperature beyond all due proportion, require more food, *cœteris paribus*, than the warmly clad; because more carbon is consumed in maintaining the bodily heat;—and an extra coat becomes in this way, not only a luxury, or a means of averting disease, from depressed and deranged circulation, but a positive substitute for a certain amount of extra food, which the greater coldness of the atmosphere would otherwise render necessary.

Such are some of the many circumstances, which modify the necessities of the system, or the activity of the functions of the stomach; and which, independently of specific disorder of the digestive organs, may interfere with their functions, and derange them so far as to render them imperfectly performed. If

such causes are only occasional, or are but a very short time in operation, the dyspepsia may be of equally short duration, and the digestion be restored to its natural state on the removal of the disturbing or deranging cause. Even in such cases, some knowledge of the relative digestibility of the different articles of food may be very useful, and may not only avert present inconvenience and disturbance, but by possibility prevent such a morbid state from being induced as might prove to be the predisposing or the exciting cause of more severe and lasting injury to the health of the system. But if such causes are long continued, they occasion an enfeebled state of the stomach itself, and of its vital and chemical functions which may out-last the causes which originally produced it, and even continue to be, more or less, the bane and injury of the health and after-life.

In such cases and in those of original debility, with feeble and easily-deranged digestive powers, the importance of knowing as much as possible of the comparative digestibility of the different articles of food, becomes important and necessary. And indeed, it may be said to be true, in the case of every man leading the artificial life, which is necessary to every member of a civilised and advanced society, that he should be aware of what causes may contribute to the due assimilation of his food, and what may militate against the performance of these most needful and complicated processes. A consideration of how very far such a man's life must differ from

that which he would have passed in a state of primitive barbarism, will readily show how great must be the power of adaptation in his economy, to enable him to maintain a healthy system under such very different circumstances; but it will, at the same time, indicate that whatever interferes with, and perhaps even whatever does not serve to promote, such adaptability, must be a remote cause of derangement. And, after what has been said of the great exertion called for, from the nervous and the vascular systems, in the digestion of the food,—remembering, moreover, that, excepting during some few hours of sleep, the stomach is seldom off duty,—it will be readily seen that digestion is the function most likely to be primarily deranged. And such dyspepsia becomes, in itself, a still further means of deranging the equilibrium of the circulation, and the due balance of the nervous functions; giving rise to local irritation,—local determination of blood,—sympathetic disturbance of the nervous system generally,—imperfect assimilation of the chyle into blood,—deficient or imperfect elimination of the several secretions and excretions from the blood,—among its necessary consequences; in addition to the immediate effect of interrupting the primary processes of nutrition, and producing an unhealthy chyme, or that of allowing the food to pass through the *primæ viæ* undigested, and not taken into the living economy at all. The inference is easy, that, under such circumstances, the initiative is taken to any form of morbid action that the system may be predisposed

to, whether from congenital peculiarity, or from hereditary disposition, or from the habits and circumstances of the individual life. It is well said, that a common cold, however slight, should never be neglected, on account of the very serious and even fatal consequences such neglect frequently entails; and it is at least as true, that any form or degree of indigestion should be watched and dealt with, and as far as may be prevented, inasmuch as dyspepsia is the great spring and origin of most of the diseases that flesh is heir to, or is the connecting link by which external causes of disease are enabled to influence the system. A man in the full vigour of mind and body, with his stomach's functions unimpaired and underanged, may probably be exposed with impunity to circumstances that would lead to inflammatory and other morbid actions, under less healthy conditions. The great morbific agents, cold and wet, may repeatedly find him securely fortified against their influence, until a breach has been made by stomach derangement,—the energies of the system, diverted by the local irritation from the main duty of keeping up the temperature of the surface, may prove to be unequal to resist the external depressing influence,—the surface may become chilled,—the equal distribution of the blood be interfered with,—internal congestions of blood established,—a febrile state of the heart's action, and a general irritation of the nervous powers, be produced, to combat with, and if possible remove, the local determination and congestion,—and, unable to accomplish this, or being

greater than is needed for the restoration of health, become, either in the one way or the other, causes of increased disturbance to the economy,—ending, possibly, in inflammatory action of some of the great and vital organs of the body. The physiology and pathology of digestion are indeed closely and intimately allied to one another; and not only so, but while the one is connected with health, and is its primary element, the other is equally connected with disease, in nearly all its forms,—being either its first cause, or its predisposing circumstance, or its direct means of fixing and establishing itself in the system. The morbid agent may then succeed in depressing the temperature of the surface, in disturbing the equilibrium of the circulation, in lessening the quantity of blood in the superficial vessels, in determining it unduly to some of the internal organs, in producing a congested condition of that organ, for the relief of which an excited state of the heart's action and an irritated state of the nervous system may be sympathetically set up; and all this may terminate in a triumph of the powers of the system over the incipient morbid condition, in the restoration of the balance of the circulation, and an immediate restoration to perfect health,—or the sufficient cause by which this happy termination may be prevented, may be so much disturbance of the digestive functions as diverts from their duties the general powers of the system. Should morbid action, however, have been set up, the importance of attention to the functions of the stomach becomes of still more immediate and

paramount consequence; and this, not only from the probability of the digestive powers being at once enfeebled and disposed to derangement, from the diversion of nervous and vascular power to the seat of diseased action, and from the increased excitability of the general system; but because, even if capable of digesting it, the amount of nourishment taken may be too much for the excited and febrile condition of the system; or because the food may be of too exciting a quality; or because there is much risk of adding to the disordered state by superinducing dyspepsia, or by risking the probable irritation that would be caused by the passage of crude and imperfectly digested matters along the course of the intestinal canal; or finally, because the more unirritating and the more easily digested the food that has to be needfully taken, the less likely is its conversion into chyle to call upon the system for much of that power, which should be diverted as little as possible from the more important and pressing duty, of meeting, and endeavouring to carry through, and terminate successfully, the morbid condition.

The question of diet then, whether in health or disease, has a very important and prominent position in any system of hygiene or of medicine,—and, as has been said, a more important position, the more artificial, the farther removed from a state of barbarous labour, the state of mankind may be. The more fully the physical conditions of life and health are fulfilled, the less needful must be the regulation

of the diet, either as to its quantity or quality. If man is to breathe the fresh and unvitiated open air during the greater part of his working hours,—if he is to labour daily and severely for his subsistence,—if the body is used so much, and the mind comparatively little,—attention to the diet may be of little moment, even if any variety or abundance of appetising viands were by possibility attainable, which, under such circumstances, would be most unlikely. But if man is to spend his life very differently,—shut up in the closer air of a town, passing the great majority of his hours within doors, and possibly in an apartment where the direct rays of the sun seldom or never enter, and which may be very imperfectly ventilated,—engaged in an occupation that confines him to his chair, or limits his bodily exertion to an occasional and uniform change of position, or to a series of slight muscular movements, and calling comparatively few muscles into exercise,—and if to this be added much wear and tear of mind, whether in thought or anxiety,—the question of diet must become a matter of primary importance, even although, notwithstanding any amount of attention to it, the most that can be hoped for in the case may be, to diminish the amount and severity of the dyspeptic symptoms, and to maintain the man's system in a state nearer to that of health than it otherwise could be. The importance of attention to diet,—the selection, and it may be the restriction of the food, as to its quality and quantity,—is the greater, inasmuch as civilised man is placed above the necessity

of a simple and little varied diet, in almost all the cases even of the poorest of the people. Alcohol in its many forms, spices of all kinds, are so many provocatives to disturbance, to false appetite, to excess, to derangements of the nervous and vascular systems, and eventually to defective assimilation of the ingesta.

It is not to be wondered at, that, in a commercial country, where sedentary occupations are the lot of a very large proportion of the people, and a mode of living which might almost with justice be called omnivorous is within the reach of all but the lowest grades of society, so few should be found who are free from stomach derangement, and who are not more or less dyspeptic. There are few instances of such perfect health; and there are therefore few who are in a situation to neglect all dietetic regulation, and to eat without risk whatever is put before them. But even the few who have such absolutely unimpaired powers of digestion, will be found to consist chiefly of those who live and have always lived plainly and frugally,—who have, either from necessity or from habit, dieted themselves. The few, the very few among them, of whom this cannot be said, are, if middle-aged, men who have taken a great deal of exercise; or they are the young, who have had constitutions of iron to begin with; which constitutions it sometimes takes much hard work to wear out. Man was destined to work for his food. Thus is provision made for that, which is so much neglected by all classes, but those of

whose occupation it is part and parcel: to wit, exercise. Unaided by his fellow-men,—destitute as yet of the advantages which a division of labour and commerce supply,—his food would of necessity be confined to the few simple herbs, which his own toil could extract from the earth, or to the animals which he had earned by his exertions in the chase. Here then are two of the first, and the two most important regulations, of which modern dietetics inculcate the observance,—viz., exercise and simplicity of diet. For the best of all reasons, a man so situated would not indulge in the use of stimulants; he would not know either that they could be procured, or how to procure them; and consequently, neither from ale, nor wine, nor spirits, would he run any risk. And here we find the third section in nature's scheme of diet,—viz., sobriety; and a sobriety, it will be observed, that is not merely the comparative degree of drunkenness, but positive temperance, complete abstinence from stimulating liquids. This then may perhaps be said to be the natural state of man; the state in accordance with which his organs were formed, and the several tissues of his body were fashioned and modified; the kind of diet and regimen, from which the more he varies, the more does he oppose the dictates of nature, the more does he expose himself to the influence of disease, the greater risk does he incur of essentially curtailing his existence, and the more active and energetic must be the interference of art, to counteract as far as possible such consequences, and to spin out his exist-

enee. This then is the true foundation of dietetics,—the guide to sueh a diet and regimen, as may best serve to keep man in health, and to restore it to him when he has lost it.

The digestion and assimilation of food subserve the great purposes of maintaining the elevated temperature of the body, and of restoring the waste and repairing the expenditure of the system. The animal body consists especially, and perhaps essentially, of earbon, oxygen, hydrogen and nitrogen, together with lime, sulphur, phosphorus and iron; the whole being in different states of combination, as to proportion and as to arrangement, in the different parts. The fat and the water of the system are destitute of nitrogen. The other organs and textures, aceording to Professor Liebig, and most other modern ehemists, are all, with one exception, redueible to a substanee having a very similar eomposition and properties, whencesoever obtained; and this substanee, from presenting a primitive or simple type of a eompound, from which all the various tissues and organs may be supposed to be formed, has been ealled protein. To this general rule, gelatin furnishes the important exception. The basis of all the gelatinous textures, as the skin, cellular tissue, &e., gelatin is not found to be redueible to protein; and Liebig therefore believes, and at all events with very much probability on his side, that gelatinous aliments cannot repair the waste of any but the gelatinous tissues of the body; although, supposing that gelatin is not afforded in adequate quantity in the food, the gela-

tinous textures may be formed from the alimentary substances that are convertible into protein. All the alimentary substances, whether animal or vegetable, which contain nitrogen, are found to be either gelatinous, or to be reducible into three principal components, any one of which is convertible into protein. These are fibrin, albumen and casein. The fibrin separates spontaneously from the newly expressed juices of vegetables, when they are allowed to remain at rest for a very short time; and, when the colouring matter has been removed from it, the fibrin is left as a white grey substance. This vegetable fibrin is identical in composition, and in chemical and physical properties, with the animal fibrin obtained from the blood on its coagulation. The vegetable juices contain, moreover, when the fibrin has thus become separated, a substance in solution, and which remains dissolved at the ordinary temperature of the atmosphere; being, however, coagulated when the juices are heated to the boiling point. This is vegetable albumen, identical, in every way, with the albumen of the egg or the serum of the blood. In certain vegetable matters, especially the leguminous seeds, there is a third of these peculiar vegetable principles, containing nitrogen and resolvable into protein, which is soluble in water, and is so far like albumen, but differs from it in not being coagulable by heat. It forms, when heated, only a scum on the surface of the liquid holding it in solution, but is coagulated on the addition of an acid. This is vegetable casein; resembling, in all essential particulars,

the curd formed by adding acids to the milk of animals,—in this case constituting cheese, when pressed and dried; whence its name, casein. These three nitrogenised constituents of the food,—all resolvable into protein; all having the same composition with one another, whatever form they assume, and whether derived from vegetables or animals; and all directly convertible into the living tissues of the animal body, by means of the digestive functions, —are the main elements of food, and of course the direct sources from which the waste and expenditure of the body are compensated. Professor Liebig says of them:—"The chemical analysis of these three substances has led to the very interesting result, that they contain the same organic elements, united in the same proportion by weight; and, what is still more remarkable, that they are identical in composition with the chief constituents of blood, animal fibrin and albumen: they all three dissolve in concentrated muriatic acid, with the same deep purple colour; and, even in their physical characters, animal fibrin and albumen are in no respect different from vegetable fibrin and albumen. It is especially to be noticed, that by the phrase *identity of composition* we do not here imply mere similarity, but that even in regard to the presence and relative amount of sulphur, phosphorus, and phosphate of lime, no difference can be observed."*

* Organic Chemistry of Physiology and Pathology. By Justus Liebig, M.D., &c., &c.; translated by Dr. William Gregory, Professor of Chemistry in the University of Edinburgh.

The question of digestion becomes, in this view, simplified into the condition, that inorganic materials are in the first place organised, and arranged into certain principal forms of combination, by the vital powers of plants; and that thus chemically prepared, and formed into certain compound principles, having almost an identity of composition, appearance and sensible properties, with the blood and the tissues and organs formed from it in the animal system, it is capable of being once again brought within the influence of vital action, and of being again assimilated, and formed into part of an organised and living substance; from which it may be either again thrown off to be reduced to its primary elements, or be put into a different state of combination, or be placed in a condition to furnish once more a readily assimilated food for plants; or, it may be, are at once convertible, in the shape of their flesh, &c., into the food and sustenance of other living creatures. Whether derived directly from the protein of animals, or from that of plants, the organised and organisable aliments are all, in the first instance, converted into blood; and this has two great purposes to fulfil: the one, to absorb, by means of its globular constitution, the oxygen of the air inspired during respiration, to carry this important element to all the capillaries of the body, where it unites with one of the elements of the wasted and expended tissues — the carbon, evolving in the consequent formation of carbonic acid, the animal heat,—the carbonic acid being expired by the lungs, or exhaled

through the pores of the skin; the second, to supply, by means of the organs of seeretion, new materials, in thc place of those which have been thus eonsumed; and the third, to carry off what is not thus eombined with the oxygen,—viz., the nitrogen (the hydrogen combining with a eertain proportion of the oxygen, to form part of the watery vapour exhalcd in respiration, and of the liquid matters otherwise expended and escaping from the system),—and, besides the nitrogen, earrying away certain saline and earthy matters, which may no longer be wanted by the system, and are therefore not re-absorbed into it. The nitrogen thus disengaged, escapes by the kidneys and the skin. Were the views of chemieal physiology limited to what has now been stated; were it set forth, that all the carbon required for the maintenanee of the animal heat, is derived from the destruction of expended tissue; and were it conneeted with this position, as it would have to be, that all this waste or destruction must be aceomplished by exercise of the expended structures; for it is bclieved, that, in using any organ,—as the brain, in thought,—the nerves, in sensation or volition,—thc muscles, in movement,—we eause the partial dissolution and expenditure of eertain of its component atoms, and that thus only are they normally expendcd; there would be involved the neeessity for a very activc life, in order to keep the respiratory apparatus supplied with a sufficicncy of redundant carbon to maintain the animal heat; and at the same time, a eorrespondingly large proportion of nitrogen

and other components of the expended tissues would have to be disposed of, at the expense of the continued exertions of the excreting organs. And, accordingly, we find that the carnivorous animals do lead very active lives, that they do expend a large proportion of nitrogen; and we find, that if man leads a very active life, he may live almost exclusively on an animal diet; and as a matter of consequence, that the necessity of subsisting in a great degree on an animal diet, makes a great amount of muscular exercise necessary to health. Certain of the South American people of the present day, subsisting as they do on flesh and water almost exclusively, illustrate the position that people living on an animal diet may take a very large amount of exercise, with little or no sense of fatigue; and the restless and almost unceasing movements of the carnivorous animals, when confined in the cages of our menageries, is well cited by Liebig as a proof of the amount of exercise such a diet renders needful, in order to obtain by the destructive process, the carbon required for the purposes of respiration. Accordingly, our aliment is, so to speak, *diluted* with vegetable principles that do not contain nitrogen, and which are capable of ministering to the respiratory process without the disengagement of this principle, and consequently without the necessity for its excretion from the economy, and without the otherwise needless expenditure of tissues and structures, and therefore without rendering any amount of exercise necessary for the mere purposes of respiration, beyond what

may serve to expend to a needful extent, the existing structures of the body. These non-azotised principles are chiefly starch and sugar, with which vegetable food is largely diluted; and these appear to subserve no purpose in the repair and renewal of the wasted and expended muscular or other azotised tissues, which require nitrogen to renew and repair them; but to be simply meant as sources from which the respiratory or free carbon may be directly supplied; and of this carbon, the fat of the system may be, in part at least, intended to serve as a reservoir, in the formation of which any superfluous carbon of the food may be made use of, and by the expenditure of which any deficiency in the direct supply of carbon may be made up for.

Such are a few of the chemical views of Liebig and his followers, as to the great questions connected with the assimilation of the food, and its purposes of repairing the waste of the system, and maintaining its temperature; and further illustrations and remarks on these important and practical views will have to be given, from time to time, in the prosecution of the different branches of our subject. Enough may have been said by way of preparation for an inquiry into the relative digestibility of the different articles of food. It may, however, be added in this place, that the chief use of the liver appears to be that of eliminating and emulging the carbon, which in the bile is united with an alkaline matter, the latter being probably drawn from the circulation, to set at liberty the acid with which it

had been combined, in order that this might act upon the food in the stomach, — and, having answered that purpose, and descended with the food into the bowels, to re-unite with the alkali, form a neutral salt, and re-enter the current of the circulation as a simple saline,—in the course of time, to be again decomposed into acid and alkali, for the digestion of the food, and possibly to aid in the elimination of the carbon, or to be gradually expended in the different excretions, and its place supplied by the saline matter contained in the alimentary supplies. In the meantime, the carbon emulged by the liver is partly carried at once to the lungs, to serve its respiratory purposes, and partly conveyed in the first instance into the bowels, in the form of bile; the greater part of which is reabsorbed into the system in its passage through the intestines, having served its purposes in the secondary digestion of the aliment; the remaining and superfluous carbon becoming excrementitious.

Many experiments have been made, to prove the comparative digestibility of the different kinds of food most ordinarily used by us. The secretion of the stomach has been collected,—food of different kinds has been put into it, in vessels kept at the temperature of the body;—and deductions as to the different degrees of digestibility have been drawn from such experiments. The evident sources of fallacy that must occur in such experiments;—the probable difference in the gastric secretion obtained for the different experiments, — the absence of all the

accessories to the stomach's action, in the mastication, in the intimate admixture with atmospheric air, by means of the saliva, the oxygen of which may answer an important purpose, while the nitrogen may readily escape through the membranes, and thus be insensibly removed from the body, as through the pores of the skin,—the absence of the important influence of the salivary diastasa, especially in the digestion of fecula,—the absence of the vital action of the stomach, and of the probable adaptation of the solvent power of the gastric juice to the variety of food undergoing solution,—are reasons why little or no dependance can be placed upon the results of such trials, and no trustworthy deductions drawn from them. Other experimentalists have introduced food into the stomach, enclosed in perforated balls; by examining which, at regulated intervals of time, they have endeavoured to determine in how long or how short a relative time, the solution of the solid contents of the balls might be effected. This again is liable to the same sources of error as the other order of experiments, and would be as likely to mislead as to assist enquiry. The most trustworthy experiments of this kind with which I am acquainted, were instituted, under peculiar and most singular circumstances, by Dr. Beaumont, of Plattsburgh, in the United States, and have been detailed by him in a work devoted to the subject. The case is likewise given at length in Dr. Combe's very able work on Digestion and Dietetics, to which the

reader is referred for a more full account of these interesting experiments. It may be enough to give here a brief summary of the experiments and their results.

Alexis St. Martin, a Canadian, eighteen years of age, having a good constitution and robust health, was accidentally wounded by the discharge of a musket, on the 6th of June, 1822. The charge was received in the left side, at the distance of a yard from the muzzle of the gun. The shot, mixed with powder, entered the body from behind, passed forward and inward in an oblique direction, literally blowing off a portion of the integuments and muscles, of the size of a man's hand; fracturing and carrying away the anterior half of the sixth rib, fracturing the fifth; lacerating the lower portion of the lungs and the diaphragm, and perforating the stomach.

Thanks to an extraordinary constitution, and the skill and attention of Dr. Beaumont, this young man recovered. The wound into the stomach had sloughed, lacerated portions of the stomach had come away, the edge of the orifice had healed, but the opening had never closed. A year after the accident, the injured parts were all sound; a perforation into the stomach remaining open, of two inches and a half in circumference. The food could only be retained in the stomach by means of a compress over the aperture, secured by a bandage, till some months after this time, when a fold or doubling of the inner coat of the stomach appeared, and

gradually increased in size, until it filled the aperture, and aeted as a valve, prcventing eompletely the eseape of any of the eontents of the stomaeh through the aperture, but being easily pushed back from without, so as to admit of any thing being put into the stomach or taken out of it. The man was now in perfect health; the facility of observation had never been equalled, and Dr. Beaumont availed himself, in the most masterly manner, of the opportunity thus afforded.

"In the Spring of 1824, the individual had recovered his natural health and strength. The aperture in the stomach still remained, but thc surrounding wound was firmly cieatrized to its edges. From this period to the present time, he has enjoyed general good health. He has been active, athletic, and vigorous; exercising, eating, and drinking, like other healthy and active people. For the last four months, (of the Autumn of 1833,) he has been unusually plethoric and robust, though constantly subjceted to a eontinued series of cxperiments on the interior of the stomach; allowing to be introdueed or taken out, at thc aperture, different kinds of food, drinks, various instruments, and the different contents of thc stomaeh, almost daily, and sometimes hourly.

"The pcrforation through the eoats of the stomach is situated about three inehes to the left of the cardia, ncar the left superior termination of the great eurvaturc. On pressing down the valvc when thc stomach is full, thc contcnts flow out copiously.

"When the stomach is nearly empty and quiescent, the interior of its cavity may be examined to the depth of five or six inches, if kept distended by artificial means; and the food and drinks may be seen entering, if swallowed at this time, through the ring of the œsophagus. When entirely empty, the stomach contracts upon itself, and sometimes forces the valve through the orifice, together with an additional portion of the mucous membrane, which becomes completely inverted, forming a tumour as large as a hen's egg. After lying on the left side, and sleeping a few hours, a still larger portion protrudes, and spreads out over the external integuments, five or six inches in circumference, fairly exhibiting the natural rugæ, villous membrane, or mucous coat, lining the gastric cavity. This appearance is almost invariably exhibited in the morning, before rising from bed."

It was in May, 1825, that Dr. Beaumont began his first series of experiments on this extraordinary case; and in the following August, St. Martin returned to Canada, and remained there four years. He returned to the United States in 1829, and now entered into Dr. Beaumont's service, for the purpose of a second series of experiments, which he continued uninterruptedly until 1831. He then went back again to Canada, coming back to Dr. Beaumont in 1832; and with the interruption of about three months, the experiments continued to November, 1833.

"The usual method of extracting the gastric juice,

for experiment, is by placing the subject on his right side, depressing the valve within the aperture, introducing a gum-elastic tube, of the size of a large quill, five or six inches into the stomach, and then turning him on his left side, until the orifice becomes dependent. On introducing the tube, the fluid soon begins to flow, first by drops, then in an interrupted, and sometimes in a short continuous stream—moving the tube about, up and down, or backwards and forwards, increases the discharge. The quantity of fluid ordinarily obtained is from four drachms to one and a half or two ounces, varying with the circumstances and condition of the stomach. Its extraction is generally attended by that peculiar sensation at the pit of the stomach, termed *sinking*, with some degree of faintness, which renders it necessary to stop the operation. The usual time of extracting the juice is early in the morning, before eating, when the stomach is empty and clear."

The fluid thus obtained was clear and transparent, inodorous, a little saltish, and very perceptibly acid to the taste; having the flavour, when applied to the tongue, of thin mucilage slightly acidulated. It very speedily diffused in water, wine, or spirits; slightly effervesced upon the addition of alkalies; coagulated albumen in an eminent degree; and was found to be powerfully antiseptic, by checking the putrefaction of meat. The mucus, which was always more or less mixed with it when first obtained, giving to it a degree of ropiness, soon sepa-

rated from the fluid in loose white flocculi, falling to the bottom of the vessel containing it. Saliva imparted to the fluid an azure tinge and frothy appearance. Derangement of the digestive organs, slight febrile excitement, fright, or any sudden emotion, was found to occasion an important alteration in its appearance; and excess in eating caused a rancid state of the fluid, and sensibly diminished its solvent properties.

The solvent action of the gastric juice was proved most conclusively by Dr. Beaumont's experiments. Almost every kind of alimentary matter, whether animal or vegetable, when submitted to the action of the fluid taken from the stomach, and kept at the temperature of about 100 degrees of Fahrenheit's thermometer, was found to become, in the course of a few hours, completely softened, and reduced to a pultaceous state. The rapidity of solution depended much on the mechanical condition, as to tenderness or minute division, of the aliment submitted to the action of the fluid. Milk and the different forms of liquid albumen were found to be in the first place coagulated by the gastric juice, and then dissolved by it. It seems to be proved by the experiments, that cold gastric juice has little or no solvent power. In one instance, a piece of roasted beef was submitted to the action of the fluid, in the open air, at the temperature of thirty-four degrees; and, after twenty-four hours, was found to be unchanged; whereas, when the temperature was raised to 100 degrees, it was

speedily dissolved. Dr. Beaumont has found, however, that the gastric juice does not accumulate in the stomach during the intervals of digestion, as was at one time believed to be the case; but his experiments show that, on the contrary, it is only secreted when food or some other stimulus is brought into direct and immediate contact with the lining membrane of the stomach. When not containing food, the stomach was usually observed to be contracted, the rugæ of its inner coats folded irregularly upon one another, the lining membrane being of a pink colour, of a soft velvet-like appearance, and covered constantly with a very thin, transparent and viscid mucus. When the tongue was applied to the mucous membrane of the stomach, in the empty and unirritated state of the organ, no acid taste was perceived; but when food, or other irritant, was in contact with the membrane, and the gastric papillæ consequently excited, an acid taste was immediately perceptible. The ordinary temperature of the interior of the stomach was found to be about 100 degrees. A dry state of the atmosphere was found to increase, and a damp one to diminish the temperature. Active exercise was found to raise the temperature about one degree and a half, whatever might have been its previous temperature. When food was received into the stomach, the action of the vessels of its lining membrane was perceptibly increased; the membrane becoming of a brighter red colour, the vermicular movements of the organ being excited,

and the secretion of gastric juice commencing. It was observed that when a portion of food entered the stomach, the rugæ of the organ closed upon it; and if the ingesta were sufficiently fluid, they were found to be gradually diffused throughout the lining membrane; the contraction of the rugæ appearing to exclude the rest of the food until the first portion had been duly mixed with the solvent, when the rugæ relaxed, to contract again upon a new portion of the alimentary mass. It was, moreover, found that food taken in a liquid form, as soup, &c., is deprived by absorption of much of its aqueous portion before it is digested. The results of Dr. Beaumont's experiments on the digestion of the different kinds of food, are very well given in the following table:—

Table, showing the Mean Time of Digestion of the different Articles of Diet, according to the Experiments of Dr. Beaumont, in the Case of Alexis St. Martin.

Articles of Diet.	Mode of Preparation.	Time required for Digestion.	
		H.	M.
Rice	Boiled . .	1	0
Sago	Ditto . .	1	45
Tapioca	Ditto . .	2	0
Barley	Ditto . .	2	0
Milk	Ditto . .	2	0
Ditto	Raw . . .	2	15
Gelatin	Boiled . .	2	30
Pigs' Feet, soused . . .	Ditto . .	1	0
Tripe, soused	Ditto . .	1	0
Brains	Ditto . .	1	45
Venison Steak . . .	Broiled . .	1	35
Spinal Marrow	Boiled . .	2	40

Articles of Diet.	Mode of Preparation.	Time required for Digestion. H.	M.
Turkey, domestic	Roasted	2	30
Ditto, ditto	Boiled	2	25
Ditto, wild	Roasted	2	18
Goose	Ditto	2	30
Pig, sucking	Ditto	2	30
Liver, beef's, fresh	Broiled	2	0
Lamb, fresh	Ditto	2	30
Chicken, full-grown	Fricasee	2	45
Eggs, fresh	Hard boiled	3	30
Ditto, ditto	Soft ditto	3	0
Ditto, ditto	Fried	3	30
Ditto, ditto	Roasted	2	15
Ditto, ditto	Raw	2	0
Ditto, whipped	Ditto	1	30
Custard	Baked	2	45
Codfish, cured, dry	Boiled	2	0
Trout, Salmon, fresh	Ditto	1	30
Ditto, ditto, ditto	Fried	1	30
Bass, striped, fresh	Broiled	3	0
Flounder, ditto	Fried	3	30
Catfish, ditto	Ditto	3	30
Salmon, salted	Boiled	4	0
Oysters, fresh	Raw	2	55
Ditto, ditto	Roasted	3	15
Ditto, ditto	Stewed	3	30
Beef, fresh, lean, rare	Roasted	3	0
Ditto, ditto, dry	Ditto	3	30
Ditto, Steak	Broiled	3	0
Ditto, with salt only	Boiled	2	45
Ditto, with mustard, &c.	Ditto	3	30
Ditto, fresh, lean	Fried	4	0
Ditto, old, hard, salted	Boiled	4	15
Pork, Steak	Broiled	3	15
Pork, fat and lean	Roasted	5	15
Ditto, recently salted	Boiled	4	30
Ditto, ditto	Fried	4	15
Ditto, ditto	Broiled	3	15
Ditto, ditto, recently salted	Raw	3	0
Ditto, ditto	Stewed	3	0

Articles of Diet.	Mode of Preparation.	Time required for Digestion. H.	M.
Mutton, fresh	Roasted	3	15
Ditto, ditto	Broiled	3	0
Ditto, ditto	Boiled	3	0
Veal, fresh	Broiled	4	0
Ditto, ditto	Fried	4	30
Fowl, domestic	Boiled	4	0
Ditto, ditto	Roasted	4	0
Duck, domestic	Ditto	4	0
Ditto, wild	Ditto	4	30
Suet, beef, fresh	Boiled	5	3
Suet, mutton	Ditto	4	30
Butter	Melted	3	30
Cheese, old, strong	Raw	3	30
Soup, beef, vegetables, and bread	Boiled	4	0
Ditto, Marrow-bones	Ditto	4	15
Ditto, Beans	Ditto	3	0
Ditto, Barley	Ditto	1	30
Ditto, Mutton	Ditto	3	30
Green Corn and Beans	Ditto	3	45
Chicken Soup	Ditto	3	0
Oyster Soup	Ditto	3	30
Hash, meat and vegetables	Warmed	2	30
Sausage, fresh	Broiled	3	20
Heart, animal	Fried	4	0
Tendon	Boiled	5	30
Cartilage	Ditto	4	15
Aponeurosis	Ditto	3	0
Beans, pod	Ditto	2	30
Bread, wheaten, fresh	Baked	3	30
Ditto, corn (maize)	Ditto	3	15
Cake, corn (maize)	Ditto	3	0
Ditto, sponge	Ditto	2	30
Dumpling, apple	Boiled	3	0
Apples, sour and hard	Raw	2	50
Ditto, ditto, mellow	Ditto	2	0
Ditto, sweet, ditto	Ditto	1	30
Parsneps	Boiled	2	30
Carrot, orange	Ditto	3	15
Beet	Ditto	3	45

Articles of Diet.	Mode of Preparation.	Time required for Digestion. H.	M.
Turnips, flat	Boiled	3	30
Potatoes, Irish	Ditto	3	30
Ditto, ditto	Roasted	2	30
Ditto, ditto	Baked	2	30
Cabbage, head	Raw	2	30
Ditto, with vinegar	Ditto	2	0
Ditto, ditto	Boiled	4	30

The results of this table are highly curious and interesting; and unquestionably more so than those of any other experiments that have been made, on the comparative digestibility of different articles of food. But these results must, after all, be received with a considerable degree of qualification; and it must be admitted, that they are not so practically important and conclusive as they may, at first sight, appear to be. The several articles of food having been, for the most part, singly submitted to the action of the gastric juice, instead of having been more or less mixed with other alimentary matters, as would be the case under the common circumstances of people's diet, is one reason for receiving these results with a qualified confidence. The admitted exceptions to the digestibility of the different articles of food in the cases of different people, is another, and even a stronger reason, why any deduction drawn from a single case should be admitted doubtfully, and only admitted at all when confirming, or confirmed by, the results of general observations, founded upon a large number of ex-

amples. All this is evident, without taking into consideration the modifications produced by debility, or by disordered action of the system in general, or of the digestive organs in particular, when dietetic regulation becomes more necessary, and is more likely to be sought after. In point of fact, the dietetic question, so far as it is capable of influencing health and disease, may be said to be, to determine what kind of food may be assimilated without inconvenience to the system, or any gastric derangement or irritation, rather than within how short a time any article of diet may be digested. It is indeed true, that the longer the food remains in the stomach, and the more slow its digestion, the more likely it is to occasion derangement; but it does not therefore follow that it must do so. On the contrary, inasmuch as disease is the exception to health, so must this be the exception to the much larger number of cases, in which, notwithstanding that the food may be slowly converted into chyme by the gastric juice, whether from the mechanical or chemical resistance of the food to the action of the solvent, it may, nevertheless, be dissolved in the stomach without occasioning any dyspeptic symptom, and be eventually and fully assimilated without perceptible derangement to the system. There must then be afforded some other means of judging, as to the probable and comparative digestibility of the different articles of food; and, so far as we know, this can only be supplied by extensive and careful observation of healthy and invalided stomachs,—determining from such observa-

tion, as accurately as may be, what articles are most commonly found, either to task unduly the powers of the healthy stomach, or to derange the functions of the feeble stomach, giving rise to dyspeptic symptoms. It need hardly be said that any such observations, however carefully made, allow for many exceptions; or that it is only sought to establish such general rules, as seem to be founded upon what is observed to obtain in the majority of cases, and thus to direct and assist in determining the comparative digestibility of the different articles of food, in any individual case. And, however great the light which Chemistry has of late years thrown on the subjects of digestion and nutrition,—however satisfactorily the great chemist, Liebig, has brought his own chemical labours, and those of others, to bear upon these great phenomena,—Chemistry is able to do very little for us, in determining what substances are more easily digested, and what are less so. On the contrary, Chemistry finds very little difference of composition between gum and sugar, their relative digestibility being very different,—or between fat and alcohol, although the comparative readiness with which they are taken into the system is still more different. And although Chemistry has seemed to prove, that articles of diet which do not contain nitrogen, are only capable of ministering to the respiratory function, whereas those which contain nitrogen are exclusively capable of repairing the waste, and renewing and maintaining the entireness of the tissues and organs; not only

does Chemistry not assist in any way in determining the relative digestibility of either of these classes of dietetic substances, but the most easily and the least easily digested articles of food are found in both of these classes. And, although the alimentary articles which contain most nitrogen, might, other circumstances being the same, be admitted to be the most nutritious, and those which contain the smallest proportion of nitrogen to be the least nutritious, and the latter might therefore be supposed to be the most easy of digestion; yet this supposition would not be found to be either the general rule, or the exception to it, or any guide whatever on the subject; the digestibility depending neither on the presence nor the absence of nitrogen, nor on the proportion in which it is found to exist in any article of food. Fat, containing no nitrogen, is less easily digested than lean, which contains nitrogen in large proportion; beef, which contains a very large proportion of nitrogen, is more easily digested than salmon, which contains a much smaller proportion of nitrogen; and, on the other hand, egg, which contains much less nitrogen than salmon, is much more digestible.

If to this be appended the results of observation and of experiment equally, as to the comparative solubility by the gastric juice of animal and vegetable substances; and it be determined that some of the farinaceous articles of diet are much more easily and quickly converted into chyme than any other alimentary substances,—rice being dissolved in

the stomach, according to Dr. Beaumont's experiments, in one hour, although containing less than $8\frac{1}{2}$ per cent. of azotised matter, whereas animal substances, consisting, with the exception of fat, almost exclusively of azotised matter, require at least double this time for their chymification; and if this be compared with the relative primary digestion of rice and turnips, the former containing less than $8\frac{1}{2}$ per cent., and the latter less than $1\frac{1}{2}$ per cent. of azotised matter; yet, the former being dissolved by the gastric juice in one hour, the latter requiring $3\frac{1}{2}$ hours for its solution, the little assistance that is afforded by Chemistry in determining the digestibility of different articles of food becomes more and more apparent.

In the question of the comparative digestibility of the different articles of food, we are then reduced to the necessity of finding general rules for our guidance in individual cases, from wide and careful observations of the digestibility of the different kinds of food, in health and disease; by no means conceiving such observations, however carefully made, to be infallible; but bearing ever in mind the probability, or at least the possibility, of frequent exceptions occurring, to any one of the generalisations at which we may have arrived. In fact, all attempts to frame such general rules are liable to strictures, on the ground of so many and signal exceptions to the rule being frequently met with. But, notwithstanding such strictures, dietetic observations are of the greatest use as guides; although they may not be found worthy of implicit trust, in every detail of

every case that may occur. To prove that such observations must have much value, it is enough to show, from general experience, and universal admission, that some articles of food are almost invariably found to be less likely to agree with the dyspeptic or debilitated stomach than others are: for instance, that, in nearly all such cases, mutton agrees better than lamb, or veal, or pork; that fat, as has been said, agrees better than lean,—starch than sugar,—eggs than cheese. In regard to the attempt to arrange the different kinds of food in tabular order, with reference to their digestibility, it may now claim, after a trial of eleven years, to have undergone the test of time, and to have been proved to be useful; although it is admitted to be by no means an unvarying and certain guide.

The articles are placed, in each of the tables, in the order of their relative digestibility, beginning with those that are in general the most easily digested.

MEATS.*

1. Mutton.	3. Lamb.†
2. Beef	4. Veal.†
5. Pork.†	

Mutton is placed first in the above table. It is usually more easily digested than beef. This is probably owing to the larger size of the fibres of beef. According to the smaller size of each fibre, it is but reasonable that its digestion should be more quickly

* This mark (†) opposite to any of the substances in this or the following tables signifies that such articles are generally found to be unsuited to the dyspeptic.

performed, supposing the digestibility to be otherwise equal. But the comparative digestibility of beef and mutton depends a good deal upon many circumstances, of which the age of the animal, its being or not being in good condition, and the part that is eaten, occur to me as being the most important. Mutton is more easily digested, if it be from a four or five-year old wether, or from a two or three-year old ewe, than if it be from an animal that is younger. It seems likewise to be a well-authenticated observation, that the nearer to a state of nature that the animal has been brought up in, the wider and less confined its pasturage, the more easily will the flesh be digested. Hence, sheep that have ranged over wide tracts of country, as in the less cultivated parts of Wales or Scotland, or in certain of the uplands of England, particularly notable in Derbyshire and Devonshire, are found to afford a preferable and more digestible flesh. The same remark does not apply to beef; for the richer the pasture of the ox, the more wholesome its flesh. Yet neither beef nor mutton is so wholesome, when the animal is not in *good condition* at the time of slaughter. The flesh of an animal that is in good condition at the time of its being killed, is firmer and redder, and is fuller of nutriment. Such meat is known by its marbled appearance,—by having layers of fat in the substance of the lean. It would be a mistake to suppose, that it is the fat which produces the greater degree of digestibility. It is invariably the case, that fat is much more indigestible than lean; and although such meat should always

be selected with preference, the invalid should carefully separate the fat from the lean, and eat only the latter. The flesh of animals that have been fattened on artificial food, as oil-cake, and the like, is much more likely to disagree with the dyspeptic, than that of animals which have been fed on fresh herbage. The health of the animal has much to do, in every case, with the digestibility of its flesh; and the less easily digested the flesh of an animal may be, the more important must this fact become. It is, however, the case, that the flesh of some animals is much more susceptible than that of others of being influenced by their having been in a state of more or less perfect health at the time of slaughter. However much more digestible and nutritious the flesh of the ox, when in good condition and perfect health at the time of slaughter, having been fed and fattened on fresh herbage, or, at all events, on vegetable food, than when fattened on oil-cake; and however much the probable digestibility may be influenced by the animal having been stall-fed,—especially if the stall-feeding have been carried on in an ill-ventilated building, and the animal kept from all due exercise for some time; there is no doubt that mutton may be in these ways much more influenced in digestibility and wholesomeness than beef; and that, when mutton is said to be more digestible than beef, a free pasture, fresh herbage for food, abundant exercise, and, of course, the free respiration of a pure air, and if possible, in an upland country, are necessary conditions to the

production of such easily digested and wholesome mutton; and that, therefore, the digestibility of mutton must depend greatly on the circumstances of the animal's life, the season of the year, and the like. For these reasons, mutton may be less generally of easy digestion in winter than in summer; and, on another account, it may be less easily digested in spring than in autumn. Further: the flesh of the fully grown animal is more easily digested than that of the animal which is still growing. The ox or the sheep should not only indeed have arrived at its full growth, but have become matured, and be at the age of fullest vigour and development, in order that its flesh may be as digestible as it can become. To what this is owing is, perhaps, doubtful. It has been ascribed to the absence of the proper quantity of alkaline constituents in the flesh of the growing and immature animal,—and likewise to the larger quantity of gelatinous matter, that, in the flesh of young animals, is mixed with the fibrinous matter; the flesh of the fully grown animal consisting chiefly of the latter. It may, by possibility, be in some degree attributable to the mixture of gelatin with fibrin in larger proportion in the flesh of the growing animal; inasmuch as it is common to find that mixtures of different articles of food, having different degrees of digestibility, irritate and disturb the digestive functions when the system is feeble, or when the organs of digestion are in an irritable condition. This may, however, be exclusively owing to the greater quantity of fat beneath the skin, which obtains in young

animals, for the purpose of protecting the parts beneath from any risk of external injury, and of assisting to preserve the elevated temperature of the body,—but, perhaps, chiefly to serve as a reservoir of carbon, to maintain the respiratory process in a state of unvarying activity, at a time when all the powers of the assimilating organs are directed to the support of the growth and development, as well as to make up for the waste and expenditure of the system. We find, at all events, that when the growth and development of the system become rapid, much of the superabundant fat is rapidly expended. The fatty covering must, however, have an important influence in assisting to preserve the temperature of the body, especially when the vascular powers are necessarily feeble, and less able to resist external influences; and there can be no doubt, that, in the way the flesh of young animals is often cooked, this fat, not being removed, is absorbed by the lean during the cooking, and adds very materially to the difficulty of its digestion. The question of comparative nutritiousness between beef and mutton, veal and lamb, is simply resolvable into the flesh of the mature animal containing more nitrogen, and a larger proportion of the elements of protein, than that of the growing animal.

Whether the reasons given above, why the flesh of young animals is less easily digested than that of animals which have attained their full growth, be the true reasons or not, is, perhaps, of only secondary importance. The fact remains undeniable; and lamb and veal are, unquestionably,

much less digestible than beef and mutton. This has long been admitted in regard to lamb; but veal was, until a comparatively recent time, regarded as a proper article of diet for invalids and convalescents,—is so spoken of and recommended by the older authors on diet,—and is still generally thus regarded by the public; and it becomes important to state it, as an unquestionable and proved fact, that veal, however cooked, should be banished from the sick-room,—that the invalid, unless he enjoys a very peculiar idiosyncracy, will generally find it to disagree with his stomach.

Pork is very difficult of digestion. The fat is so intimately mixed with the lean, the tissue between the fibres contains so much of it, that it is utterly impossible to separate the one from the other. But, although pork is by no means suited to the stomach of the invalid, and seldom if ever agrees with it, yet to the stomach having unimpaired powers, it seems to be a useful and economical article of diet. But a man must have unimpaired powers of digestion to render it nourishing, and a stomach that is not easily irritated to render it wholesome. What has been said, as to the digestibility of the flesh of young animals, applies particularly to pork. There are few among the sedentary, the studious, or the voluptuous classes, that can eat sucking-pig without suffering, in some degree, by the difficulty of its digestion.

Much, however, as to the degree of digestibility of pork, depends upon the feeding of the animal, and

the other circumstances of its life. If pigs are fed on tainted refuse, or fish, or animal food of any kind, even very partially,—if they are not duly supplied with vegetable and farinaceous food from the first,—it is vain to expect that the flesh will be well developed and tender, and as easily digested as it is capable of being rendered. To this may be added, that the health of all animals, and perhaps especially of the pig, depends very much on the cleanly condition of the skin,—the due ventilation, drainage, and purity of the sty,—and the having a sufficient degree of exercise. There is no doubt that the system of shutting up pigs in small, ill-ventilated, imperfectly cleaned styes, which is so prevalent in England, makes pork much less wholesome and less digestible than it might be,—or that the flesh of the wild animal is more easily digested than that of the tame animal, and probably for this reason chiefly. Until the ventilation and drainage of stalls and styes are properly and sedulously attended to, and considered to be of first importance,—until due exercise of the animal be permitted, and, if need be, enforced,—enough has not been done to render the flesh as perfect and digestible as it may be; and these matters are of an importance only secondary to the due, careful and wholesome feeding of the animal throughout life, and putting it, as far as circumstances permit, into the natural conditions of existence, or those which would obtain in the wild state.

The meats, and indeed all animal muscular fibre, are, generally speaking, more digestible if broiled on

a gridiron,—still less so if roasted,—still less so if boiled,—still less so if baked,—still less so if fried.

The reason why broiled meat is so much more easily digested than meat that is cooked in any other way, is almost self-evident. The meat is cooked more quickly, and more uniformly. When meat is roasted, a large portion is cooked at once; and, in order that the internal parts may be sufficiently done, the outer parts must be over-done; and not only so, but rendered hard and tough, by their long exposure to so elevated a temperature. In a large joint of meat, however carefully it may have been roasted, it is a difficult matter to find a slice which is sufficiently, and yet not too much cooked. It is a well known fact that the greater the degree of cohesion there is between the particles of any substance, the greater must be the force exerted by chemical re-agents to act upon it. Chalk is acted upon and dissolved by muriatic acid;—if the chalk is in a state of fine powder, the action is quick, and the solution is speedily effected;—if it is in the state of marble, the action is much slower. The solvent must, in fact, be in absolute contact with every atom of the chalk before it can dissolve it; and the harder the mass is, the greater the degree of cohesion between its particles, the more slowly will the acid penetrate it,—for the outer atoms must be dissolved, before the acid can act on those within them. It is the same with the stomach: the softer, the less hard and resisting, the solid article of food, the quicker, other things being

equal, will the stomach digest it. Lean meat that is somewhat under-done is more digestible than if thoroughly cooked, and for the obvious reason, that, in the latter case the fibres are more hardened, and their reduction by the chemical action of the stomach rendered by so much the more difficult.

For the same reason, stews and hashes ought to be forbidden to the dyspeptic. He had much better eat his meat cold, on the second day of its appearance at table, than incur the risk of having it over-cooked, by being warmed-up again in any of the various ways that cooks and cookery-books are so fond of. Any observer would feel little hesitation in saying, that there are few dyspeptics who can eat with impunity hashed or stewed meats. This should be urged the more earnestly on the dyspeptic's attention, because it is a common notion that meat "done to rags" must be very digestible. But, if the toughened fibres are to be eaten, this is very far from being the case; if the gravy and the jelly, into which the fibres have been in part dissolved, are to be eaten, and not the fibres themselves, the question is different, and will be considered presently. Meat done to rags is, however, for the most part, meat on which heat has acted to such a degree, as to have dissolved the substances which connect the fleshy fibres together; not so far as to have dissolved those fibres, but only so far as to have rendered them as hard and tough as possible, and so to render their solution by the secretions of the stomach as difficult as possible.

Other objections may be made to hashes and stews, in addition to those that have been mentioned. They frequently—it might be said, commonly—contain much fat, skin, &c.; they are a mixture of liquid and solid food, which usually disturbs a stomach that is out of health; a large amount of seasoning enters usually into their composition, which irritates the disordered stomach, and at the same time communicates a false appetite, and tempts the individual to eat more than the stomach can digest without inconvenience. The large effect upon the digestion, of diminishing the necessity of mastication, and depriving the stomach of the important auxiliary influence of so much saliva, must be another reason why hashes and stews should be usually forbidden to the invalided.

Boiled meat is less easily digested than roasted meat. This may, perhaps, be owing to the extraction of so much gravy and gelatine from the meat, and the dryness and toughness of the muscular fibres consequent on the loss of those principles. Whether this be true or not, there is no doubt as to the correctness of the opinion, that boiled meat is not so easily digested as either broiled or roasted meat. Invalids in general, and especially dyspeptics, should be forbidden to eat boiled meats. This is indeed a remarkable change from ancient dietetic maxims; but it is based securely on observation and theory.

Baked meats are likewise difficult of digestion. This is to be ascribed to the empyreumatic oil, into which more or less of the fatty matters are converted

in this mode of cooking; and the empyreuma may probably be owing to the want of ventilation in ovens. If the great object, a sufficiently high temperature, could be secured, in connection with free ventilation, baked meats might probably be as digestible as roasted.

The effect of burnt fat on the digestibility of meat, is one reason why fried meat is digested with so much comparative difficulty. There is another obvious reason, viz., that the fat is not only burned, but the fibres of the meat are necessarily soaked in, and intimately mixed with it.

Salted meats are much more difficult of digestion than fresh meats. The salt contracts the fibres, and renders them tougher; and they yield less readily to the reducing power of the gastric secretions. When salted meats are dried, this toughening of the fibres is still farther increased, and their digestion is thereby rendered still more difficult. The smoking of salted meats rather diminishes their digestibility than adds to it.

For these reasons, cured hams, tongues, &c., are by no means easily digested. The fibres are rendered hard by the process of salting, still harder by that of drying; and they yield slowly to the action of the stomach. In the healthy stomach, this may be of little consequence. Food may, perhaps, remain many hours in such a stomach, without occasioning any disturbance of its functions, or even inconvenience to its nerves. The consequence is, that salted meat forms a very substantial kind of food, the

digestion of which occupies a long time; and it therefore satisfies the appetite for a considerable period. But no kind of food will remain for a long time quiescent in the disordered stomach; and any article, the digestion of which is tedious, will, almost necessarily, produce disturbance.

Bacon has been much vaunted as a remedy for indigestion. In the large majority of such cases it can not be so; but, on the contrary, must tax still further the powers of the stomach, or irritate still further its tissues, which, under such circumstances, may be already in a state of morbid sensitiveness.

Bacon is obtained from the most difficultly-digested of the meats, the fleshy fibres of which are toughened by the salt and by the drying. That fat is rendered more digestible by being impregnated with salt, is an admitted fact; and this must, of course, qualify these strictures on the use of bacon. But the lean of bacon is rendered more difficult of digestion, by the same process that has increased the digestibility of the fat; and the fat is not by any means so altered in character, as no longer to irritate the debilitated or disordered stomach. I have no hesitation in saying, that in the greater number of cases of dyspepsia, bacon does harm. It must do harm in all cases where the secretions of the stomach are either deficient in quantity, or vitiated in quality, and where the tissues of the stomach are in a state of irritation, or of morbid sensitiveness, and, à fortiori, in all cases, where there is subacute or chronic inflammatory excitement; in fact, when the indigestion

has its *seat* in the *stomach.* But when the secretions of the stomach are sufficient in quantity, and healthy enough in character, to mix with the food, and act on it chemically,—and when the membranes of the stomach are not in a state of irritability; and, in short, in all cases where the food is duly digested by the stomach, is ejected from it in the proper state into the bowels, and where all that is wanting is a stimulus to carry the mass forward through the intestines, the laxative properties of the fat and salt contained in the bacon will act beneficially, and to such cases bacon will, no doubt, be of service. It will be admitted, that such cases as these constitute a very small minority of the cases of dyspepsia. If the remote causes of indigestion are considered, the truthfulness of the foregoing will be still more obvious. Indigestion is, in most cases, a consequence of neglected exercise, and of taking more food than is required for the expenditure of the system. And, however engendered, dyspepsia is usually accompanied by a more or less irritable and easily excited condition of the membranes and glands of the stomach; and it is a matter of much importance to avoid food that will directly irritate those tissues and organs, or the digestion of which will give them much to do. These constitute strong objections to the use of bacon—the fat of which is so highly carbonaceous, and so difficultly assimilated, and the salt of which is directly stimulating—in the ordinary cases of dyspepsia.

The visceral and glandular parts of animals, such

as brain, heart, liver, kidney, tongue, tripe, &c., are generally difficult of digestion. The sweet-bread (*pancreas*) is a partial exception to this rule. In the case of many invalids, and not a few dyspeptics, the sweet-bread is easily digested. It is, however, questionable whether this is true in the greater number of such cases.

Animal food is almost always more easily digested, if it has undergone some degree of putefractive change; at least to such a degree as is sufficient to make the fibres more tender. If the change has proceeded to a greater extent than this, it generally induces a degree of nausea, and either interrupts or disturbs the digestive process.*

POULTRY.

1. Fowl.
2. Turkey.
3. Duck.†
4. Goose.†

Birds are usually more digestible in proportion as they are younger. The fibres of birds not only lose the greater part of the gelatinous intermixture as the animals become older; but the fibres become harder, and tougher, and by so much less and less digestible. They furnish a more gelatinous and less fibrous, a lighter and less nourishing kind of food,

* The power of the gastric juice in counteracting and correcting putrefaction is a most important and wonderful provision. Although more remarkable and useful in some animals than others, as for instance in those that feed on carrion, it is nevertheless sufficiently important in the case of man. But for this, even slightly tainted food absorbed, unaltered in character, into the circulation, must have acted as a direct and almost certain poison.

when they are young, than when they are mature. Duck and goose are marked in the table as being of difficult digestion. It is an observation which is applicable, with few exceptions, to all water-birds. They are much fatter, their flesh is tougher, and it is so thoroughly mixed up with fatty cellular substance, that the *civilised* stomach must be in a state of unusual healthiness, or have a most unusual idiosyncracy, to be capable of digesting either duck or goose, without inconvenience.

Domestication is admitted to have much effect on the flesh of the gallinaceous tribe. They are thus rendered more fleshy, and more tender, and probably in the same degree more digestible. The mode of feeding, and other circumstances of the management, influence likewise the digestibility and wholesomeness of poultry. There is no doubt, that, whereas regular and adequate feeding, and free exercise in a pure air, adds to the fleshiness and the digestibility of poultry, confinement and over-feeding adds rather to the fat than the flesh, and renders it less easily digested. As in other cases, the more necessarily difficult of digestion the species may be, the greater the effect of the mode of feeding; and ducks and geese are more affected as to their wholesomeness, by insufficient or improper food, than fowls or turkeys are found to be. The guinea-fowl and the pea-fowl are sufficiently easy of digestion; although not so digestible as the common fowl.

Poultry is more easily digested when broiled; is somewhat less digestible when roasted; and is least

easily digested when boiled. The less it is mixed and qualified with sauces and stuffing, the more easily is it digested.

As to the parts of animals that are the most easily digested,—it is a good general rule, admitting, of course, of some few exceptions, that the fleshy fibres which are least used, are the most tender, the smaller, and the most easily digested. Thus, we find that the loin of beef and mutton, the breast of poultry, and the thighs of game birds, are usually the parts selected for their tenderness, and consequent digestibility. The degree to which any part is free, or can be separated, from skin, fat, or cellular membrane, influences very much its digestibility.

The effect of confinement, exposure to a high artificial temperature, and over-feeding, on the flesh of poultry, is particularly remarkable in the turkey and the goose, and especially in the latter. By these means the liver of the goose becomes three or four times larger than its natural size, owing principally to an expansion of its cells, which become filled with fat. There is thus produced the important ingredient of a viand much prized by gourmands, but which must be necessarily difficult of digestion. And, although in a much less ratio of difficult and doubtful digestibility than the *Patè de Foie Gras*, it is questionable if the crammed turkey, the enormous proportions of which grace our tables at Christmas-time, affords so easily digested a flesh as the bird which arrives, by the aid of natural appetite alone, at so much more moderate a degree of development.

GAME, &c.

1. Hare, hunted.
2. Partridge.
3. Pheasant.
4. Venison.
5. Grouse.
6. Ptarmigan, Black-cock.
7. Hare.
8. Pigeon, Lark, &c.
9. Rabbit.
10. Woodcock, Snipe, &c.†

Game is generally very easily digested. The long-billed birds are the exception to the rule; and they should be forbidden to the decidedly dyspeptic. Season is deservedly and universally believed to influence in a remarkable degree the digestibility of the wild animals that are used as food. Age likewise adds to the alkalescence and to the toughness of the flesh, and renders it by so much less digestible. Broiling or roasting are the preferable modes of cooking game; but, however dressed, if young, and in season, game is very easily and quickly digested, and in proportion to its nutritiousness, seldom gives the stomach much to do. The distinction which is made in the table, between the digestibility of hare that has been killed by hunting, and one that has been in any other way deprived of life, will be generally admitted to be correct. The place occupied by venison in the table, may be considered by some to be a matter of doubt. This doubt will be found, however, to be attributable to the mode of cooking, and the accompanying sauces. Few who had eaten a broiled venison steak, would have reason to find fault with its digestibility. The tamed or home-fed pigeon and rabbit are, probably, if kept in good health by proper feeding and cleanliness,

much more digestible than the wild pigeon, or wild rabbit. There is usually less of the peculiar flavour of the flesh, which may depend on some essential oil, and which is so much influenced in all animals by season, age, and diet. It is not generally the case, however, that home-fed animals are more easily digested than wild animals. The fact that game is usually so easily digested, is sufficient proof to the contrary. And indeed, in general, home-fed or pastured animals, by being made to lead artificial lives, deprived more or less of the power or inclination to take much exercise, or the necessity for doing so reduced by good pastures, are by so much rendered less easily digestible. As exercise expends the redundancies of the system, and maintains in full activity the assimilating organs, it renders the muscular fibre more developed, firmer, more free from fat and gelatinous matters, and by so much more nourishing, and more digestible. This is a rule, however, which must be admitted with qualification; and one that, on the one hand, probably depends on the degree to which the home-feeding is carried, and to which due exercise is interfered with; and, on the other hand, on the readiness or difficulty with which the wants of the animal are supplied by its own exertions. It becomes, in fact, a question of good and perfect health, attained by sufficient food and adequate exercise, and not interfered with by an accumulation of redundant fat.

The animals of which the flesh is used as human food in this country, are, exclusively, herbivorous or

graminivorous. The flesh of carnivorous animals is acrid and strong, and much less easily digested. This is so much the case with all animal products that are not derived directly from vegetable substances, or from food consisting of a large proportion of vegetable substances, that it is said by many observers, infants will refuse, or be much disordered by the milk of nurses, who live too much on an animal diet.

ANIMAL PRINCIPLES.

1. Gravy.	3. Fibrin.
2. Gelatin.	4. Fatty Matters.††

In the table, the common animal principles are classed in the order of their relative and ordinary digestibility.

Under the first head, gravy, is included simple beef tea, made very strong, from lean beef,—allowed to cool,—the fat, then risen to the surface, wholly removed,—and warmed for use, with the addition of only a few pepper-corns, and a little salt. This is a kind of food which agrees well with most dyspeptic stomachs; or, at all events, with most of the cases that are not of severe character.

This should not be confounded with the degree of digestibility of broth; nor should the question of broth be mixed up with that of soup, which, again, is a matter for separate consideration.

Broth, or a weak decoction of the more soluble parts of animal fibre, seldom agrees with the dyspeptic, or with the merely feeble stomach; and,

of course, more seldom with the former than with the latter. The first great objection to broth is the fat, of which it almost always contains more or less, unless it has been allowed to stand until quite cold, and the fat wholly removed,—the broth being warmed again for use. This objection may be thus easily got rid off; the next to be mentioned is consequently of more importance. It will usually be found in the case of the dyspeptic, and not unoften in that of the debilitated invalid, that liquids of any sort, provided they hold nutrimentary matter in solution, produce a sense of fulness and uneasiness of stomach during their digestion, even when they do not occasion any more marked symptoms of disturbance in the stomach's functions. This effect is very apt to be produced by all sorts of unthickened slops. It may be that they dilute too much the gastric secretion, or that their bulk causes them to be less readily and promptly submitted to its action. The difficulty with which those liquids holding alimentary matters in solution are digested, is so general, and affords so few exceptions, that unthickened chicken broth, or mutton broth, should seldom be allowed to the invalid or the dyspeptic. When thickened with arrow-root, or with any of the simple farinacea, they often agree sufficiently well, and form a light, palatable, and nourishing diet.

Broth with vegetables in it, is, for reasons which will be understood by referring to the remarks made under that class of substances, highly objectionable

in the case of the invalided, and should never be eaten by the dyspeptic.

Gelatin is, in general, of easy digestion. When the stomach is labouring under mere debility, as during convalescence from severe and exhausting illness, it is usually found that jelly, made from calves' feet, ivory dust, &c., is a grateful and palatable, a safe and unirritating step, from farinaceous to more solid animal food. But this remark is hardly applicable to the dyspeptic stomach, which, if suffering from debility, is seldom suffering from debility alone. When the gastric secretions are either deficient or disordered,—when the stomach is irritable or morbidly sensitive,—and still more if the organ be in a state of subacute inflammatory excitement, jelly will usually be found to be objectionable. I must say that I would rather, speaking generally, see a dyspeptic patient of mine eat a somewhat underdone broiled mutton chop, than jelly of any sort, made in any way, or from any source. If the views of Professor Liebig are correct, and that they are mainly so will hardly be questioned, gelatin is of little use as food, unless to repair the waste of the gelatinous tissues. But these tissues constitute a very large and important proportion of the system; and the mere business of ministering to the restoration of their expenditure might well be a reason for letting gelatinous matters form a part of the food. In convalescence from illness, when the skin is evidently attenuated, and the cellular tissue as evidently wasted, and in part absorbed, the usefulness of gelatinous

food becomes, in this view, very apparent, and the propriety of the time-honoured custom of giving jelly in some form to our convalescent patients is confirmed,—however doubtful, it may still be maintained, is the propriety of allowing gelatinous food to the cases of dyspepsia.

The digestibility of fibrin has been already considered under the heads of meat and of gravy; the former consisting of solid fibrin, and the latter of fibrin in a state of solution. Its ultimate composition,—differing therein very little from the composition of albumen and casein,—is, according to Mulder: Carbon 54·90, Hydrogen 6·95, Nitrogen 15·89, Oxygen 21·55, Phosphorus 0·35, Sulphur 0·36. The three animal principles convertible into protein—albumen, fibrin, and casein—differing very little from one another in ultimate composition, and being, in fact, convertible into one another,—differ from gelatin especially, in containing sulphur and phosphorus as essential elements of their constitution. Sulphur and phosphorus do not appear to be essential to the composition of the purely gelatinous tissues; being added when gelatin is about to be converted into the bony or horny textures, besides the needful deposition of earthy matter. According to Mulder, the ultimate composition of gelatin is:—Carbon 50·048, Hydrogen 6·643, Nitrogen 18·388, Oxygen 24·921. "For the same amount of Carbon," says Professor Liebig, "Gelatin contains more Nitrogen, Hydrogen, and Oxygen, than the constituents of the blood. We may suppose, that by the separation

of a certain quantity of these elements from the gelatin, a body may be obtained, which, in reference to the proportion of Carbon, Nitrogen, Hydrogen, and Oxygen, shall have a composition identical with that of the constituents of blood; but, so far as our knowledge extends, we are not acquainted with any process in the organism by which such a compound could be supplied with the sulphur, in which it is deficient." (Op. Citat. 3rd edition). In other words, on a large scale, the albuminous tissues could not be renewed by means of gelatin. On a small scale, and for a special purpose, this may be done, and is probably often done; but it would seem that, in such a case, some other part of the economy must be deprived of earbon and sulphur in the same proportion.

Fatty matters are placed lowest in the table, and marked as being considered to be very indigestible. Fat is with difficulty reduced to chyme by the action of the gastric juiee; and, failing its due and perfect reduction in a given time, is apt, or almost certain, to derange and irritate the stomach and its functions, producing acrid secretions, and increasing the quantity of the gastric secretions at the same time that their quality is deranged; and thus an additional irritant of the stomach is produeed, besides that of the slowly and imperfeetly assimilated fat. The digestibility of fat is, moreover, much affeeted by the mode in which it is cooked. If unduly heated, it becomes partially decomposed, and it is by so much rendered less digestible; and if too much cooked,

although not unduly heated, it becomes harder, and by so much less easily digested. The effect of the vegetable acids in promoting the digestibility of fat, and likewise the similar influence of the common culinary salt, are very great and remarkable, and will have to be mentioned in their proper place hereafter. The opinions as to the advisability and necessity of eating fat, have been much modified by the recent chemical views of its uses in the economy. Containing no nitrogen, fat subserves no purpose in repairing the waste of the system: its single purpose is to supply carbon for the respiratory process; and thus is explained the long known and admitted fact, that fat may be eaten with much less risk of immediate or eventual derangement from it, in cold than in hot weather,—and the degree to which it is consumed in colder latitudes, becomes hence intelligible. And again, by this view, the effect of an undue proportion of fat in the diet, in surcharging the system with carbon, in overloading the liver with work, or oppressing it with its own accumulations, producing or adding to hepatic derangements,—an effect so long known, and so universally allowed,—finds a valuable and satisfactory explanation.

The ultimate composition of fat differs in some small degree, according to the animal from which it is obtained, and probably according to the part of the animal that it is obtained from. And it is certainly true, that the fat of different animals, and of different parts, differs in its digestibility. Fat may be said to contain—Carbon 79, Hydrogen 11½, Oxygen 9½.

Turtle remains to be spoken of in this place, as an animal matter of some importance as an article of food,—and one that seems likely to become more important, from the increasing facilities of communication between distant parts of the world, and from the application of the simplest scientific knowledge to the preservation of food, by inclosing it in air-tight tin cases. Turtle, as presented in carefully made soup, is a more nourishing article of food than its merely gelatinous constitution would serve to explain. It probably contains a considerable proportion of albuminous matter. In proportion to the degree of its nutritiousness, it is by no means difficult of digestion, and is not usually apt to irritate the stomach, when, in common with the rest of the system, it has been weakened by rapidly expending indisposition. For dyspeptic cases, turtle would be a more than doubtful article of food; but when people are suffering from loss of power, and perhaps from a loss of the gelatinous and carbonaceous, rather than the protein-producing substances, turtle-soup will often prove to be a valuable prescription.

Soup in general is much more easily digested than broth,—supposing that soup is distinguishable from broth by containing more animal matter and less water, and by consisting of a mixture of gelatin and gravy, instead of gravy only. A valuable article of diet for invalids may be made by mixing beef tea with calves' foot jelly, flavouring the compound according to circumstances and taste. When not otherwise objectionable, the addition of a small quan-

tity of sound old white wine to this, not only makes it much more palatable, but greatly promotes its digestibility. When thus intimately mixed with alimentary matter, wine is necessarily much less likely to prove unduly, or even perceptibly stimulating, than when taken in almost any other way. The importance of separating all the fat from soups in general, is as great as in the case of broth; and it is generally better understood in this case, and more fully carried out.

Regarded as an article of food to be occasionally resorted to for the restoration of the feeble and invalided to health and strength, soup presents a very different question to that of its forming the preliminary of the daily dinner,—when, eaten very hot, and highly charged with spices, it becomes neither more nor less than a stimulus to appetite and the primary digestion. In this view, soup is liable to the same animadversions as any other stimulus, and may be judiciously used, or abused so grossly as to involve the ultimate penalty of repletion, plethora, and deranged health. In general, the appetite and digestion should be sufficiently good to secure enough food and its due assimilation, to meet the wants of the system; and if any such habitual stimulus appears to be necessary, there must be something radically wrong, which should be regulated and corrected by appropriate means.

FISH.

1. Whiting.
2. Haddock.
3. Cod.
4. Sole and Flounder.†
5. Lobster and Crab.†
6. Oyster, raw.†
7. Fresh-water Fish in general, as Trout, &c.††
8. Turbot.††
9. Salmon.††
10. Mackerel.††
11. Oyster, cooked.††
12. Herring and Sprat.††

Taken in the aggregate, fish may be thus classed as to the usual degree of their relative digestibility :—1st, white-fleshed fish ; 2nd, flat-fish ; 3rd, shell-fish ; 4th, fresh-water fish ; 5th, red-fleshed fish ; and, lastly, the more oleaginous fish.

The more greasy the fish, and the greater the proportion of gelatin between its fibres, the more difficult it is of digestion. Hence it is not only the rich and fat fish that disagree with the disordered stomach. It is, perhaps, owing to the great quantity of gelatin they contain, that fish so commonly disturbs the stomach of the dyspeptic, and that some are not able to digest at all. This is more probably owing, however, to the nature of the peculiar animal matter on which the flavour depends, or to the greater or less degree of oiliness of every kind of fish ; or it may be partly ascribed to the watery character of the fibres.

It is undoubtedly true, that when the stomach is in such a state as not to bear much liquid food, it will seldom be able to digest fish without inconvenience. Fish ought always to be eaten with a considerable quantity of salt : it greatly facilitates the digestion. Salted fish, however, is much more difficult of diges-

tion than fresh fish. When salt is eaten with fresh fish, the fibres are not hardened by the salt; and the only effect of the salt is to stimulate the stomach so far, as to promote, or produce, its speedy digestion. In the case of salted fish, the fibres are very perceptibly hardened by the process; and, whether owing exclusively to this or not, salted fish is much more difficult of digestion than fresh fish. The more *greasy* the fish, the more salt should be eaten with it; and vinegar is usually a palatable and advisable addition. It answers the same end as salt, in correcting the effect of the fat, &c. This only applies to such stomachs as can bear a moderate quantity of acid without inconvenience.

I have affixed a double mark to some of the articles in the above table, to express my opinion of the extreme difficulty of their digestion. Oysters are usually thought to be of easy digestion. I have been led to form an opposite opinion. I think even raw oysters to be more than questionable, if the stomach is in any degree out of order; but cooked oysters are anything but easily digested, and they should be shunned by every *valetudinarian.*

The observation as to difficulty of digestion, is applicable to all the different kinds of shell-fish. Muscles, cockles, &c., are less easily digested than oysters. Prawns, shrimps, cray-fish, &c., like the lobster and the crab, have hard and close fibres that are not readily dissolved by the gastric secretions. The character of the fibres will afford a trustworthy guide, other circumstances being equal,

to the digestibility of the different kinds of fish, when, from their being less generally used, or from a fear of confusion, certain kinds are not found to be enumerated in the table. For example: the denser fibres of the skate render this fish less digestible than the turbot, and the same circumstance makes the halibut less digestible than the salmon.

Fish is much less nourishing than other animal fibre; and on this account, in some cases of undue repletion, might advisably form a part of the usual diet, or be had recourse to as an occasional or frequent substitute for meat, on the principle of a semi-fast. It may have been on this principle, as well as that of mortifying the inclination and appetites, that fish was originally enjoined in the case of some communities, to be used on certain days, or at certain seasons, instead of meat. The objections to ordering fish instead of meat are, necessarily, the risk of taxing unduly the powers of the system to assimilate it, and of irritating the digestive organs by the extra duty. Supposing the case to be otherwise such a one as renders the occasional or frequent substitution of fish instead of meat advisable, the effect on the digestive organs must be watched with care, and the fish be forbidden if its digestion should occasion disturbance or irritation. There is no doubt, moreover, that, even when assimilated, a fish diet may derange the excretions, and indirectly irritate the excretory organs, especially the kidneys; and this may have to be borne in mind, as a probable reason why fish might be justifiably forbidden to some invalids, or why it might

be very properly or necessarily discontinued, when otherwise apparently indicated.

Broiling and boiling, especially perhaps the latter, are undoubtedly the most wholesome and easily digested ways of cooking fish. Fried fish, from being cooked in boiling butter or fat, is much less digestible. If the fish be not of a greasy character, broiling is the most digestible way of cooking it; if greasy, the fat is rendered more or less empyreumatic, and by so much less wholesome, by broiling,—and boiling is then the best way of cooking it. With the exception of salt,—and in the case of greasy fish, of vinegar,—all addition to fish, in the form of sauce or condiment, of necessity renders its digestion more difficult. The melted butter with which fish is almost invariably eaten, must render it less digestible; and the dyspeptic who will eat fish, should not add butter to it in any form.

MILK.

1. Whey.
2. Milk, skimmed.
3. Milk, unskimmed.
4. Cream.
5. Curd.
6. Butter.
7. Cheese.
8. Cream-cheese.

The composition of milk varies very much in different species of animals,—and in the same species, and, indeed, in the same individual, at different times. In one of the analyses of Simon, which may be taken as a mean, he found cow's milk to contain—water, 857; and solid constituents, 143. Of the latter, he found 40 to be butter, 72 casein, 28 sugar

and extractive matter, and the remainder to consist of fixed and earthy salts.

It is one of the most curious announcements of chemistry, that milk contains all the elements of respiration and nutrition, arranged in the same way as we find them in the multiplied articles of animal and vegetable food,—these being presented in milk, in the due proportion required for the respiration, nutrition, and growth of the young animal. Milk contains fat (cream — butter), which is destitute of nitrogen, and only subserves the respiratory process; casein, (cheese), which contains nitrogen, and serves the purposes of nutrition and growth; and sugar, which is another of the organised principles which contain no nitrogen, and are therefore not capable of being converted into the organs and tissues of the body. Thus is the young animal supplied with a sufficiency of carbonaceous food, to minister to its respiration and to the maintenance of its elevated temperature, without the necessity of expending either the nitrogenised aliment, or the tissues of the body, for this single purpose,—or farther than its little and comparatively feeble movements enable it, without disadvantage, to accomplish; and thus is the nervous system of the young animal enabled to refresh its powers by frequent and long sleep, during which the great vegetative functions of developing the organs and tissues, perfecting their formation, and adding to the size of them severally, go on without drain or interruption, from the nervous power being expended either on the mental, sentient, or motor functions.

It may be added, that the milk of different animals contains a different proportion of the simply carbonaceous and the nitrogenised constituents; and this evidently for the purpose of adapting it to the wants of the young. When the young are more torpid, and less strong, and less fully developed at birth, there is the larger proportion of carbonaceous matter in the milk, to serve the purpose of respiration without the necessity of making such exertions as their feeble systems are not capable of; and, on the other hand, the milk contains more of the nitrogenised constituents, when intended as food for those animals which are more fully developed at birth, and are capable of almost immediate exertion. And what is even more surprising than this, is the long known fact, that the milk differs according to the age of the young animal for whose sustenance it is provided; containing at first a larger proportion of fat and sugar, and subsequently the proportion of these respiratory aliments diminishing, and that of the casein—the nitrogenised aliment—being largely increased. There is no doubt, that the digestibility of the milk of different animals in the human stomach is much affected by this,—or that, even in the case of cow's milk, it becomes more or less digestible according to its relative composition.

While speaking of the diet of the young, it may be observed, that an acquaintance with the researches and views of chemistry is of much importance in reference to this question; and that proof is continually being afforded, how great is the danger of

an ignorance of the circumstance, that neither sugar, fat, nor gelatin (except in so far as the gelatinous tissues are concerned) appear to contain the elements of nutrition; that this is absolutely so in the case of oily and saccharine matters; and that, in regard to gelatin, if it is convertible into the non-gelatinous tissues at all, it must be at a much greater cost and difficulty to the assimilating powers of the system. It is not to be doubted, that many children have been atrophied, and probably lost, from their food being confined to such articles of diet as starch, sugar, butter, and, perhaps it may be added, gelatin: substances incapable of doing more than minister to the respiratory functions, or renew the gelatinous tissues, and not fitted to repair the general waste and expenditure of the body. It should be impressed on the minds of parents and nurses, that, whereas one great danger arises from overloading the systems of children, and so deranging their susceptible and easily-disturbed economy, there is a greater danger of possible occurrence: that of not giving them such food as contains a sufficiency of nitrogen to meet the wants of the system, and maintain its health and power. Children are often found to do well upon a minimum amount of azotised food, until the periods of the first or the second dentition, when the extraordinary call upon the system for the development of the roots of the teeth, and the consequent protrusion of the teeth through the gums, is not adequately met, or only ministered to at the expense of the rest of the body,—and dentition

becomes slow and defective, and the health evidently impaired. The possibility of an extra quantity of fibrinous aliment,—or such aliment as is reducible to protein out of the body, and by consequence convertible into organ and tissue within it,—being required at this period of life, should be borne in mind. There is, moreover, as great a risk of children being supplied with an undue quantity of simply carbonaceous food, as of their being furnished with too scanty a proportion of azotised food. The consequence of this error, whether in the years of growth or in after-life, must be to surcharge the system with carbon,—to diminish unwisely the instinct and necessity for muscular exercise, by supplying without its intervention the whole of the carbon wanted for respiration,—to render the system torpid,—to overwork the great emunctory of carbon, the liver,—to derange its great processes,—to render the bile less fitted for its important duties,—and, finally, to disturb the digestion, and thus affect the healthiness of the whole economy. This shews fully, that, independently of the primary risk of fatty matters and sugar deranging the stomach by any difficulty in their digestion, they are apt to injure eventually, by unduly taking the place of the azotised elements, and by so much making the functions of the body sluggish, and prone to take on morbid action. Inasmuch as starch is easily digested, and rarely irritates even the dyspeptic stomach if not taken in undue quantity at a time, the risk of using this great respiratory aliment is reduced to that of surcharging

the system with carbon. Such diet is necessarily more wanted by the sedentary than the active;—more wanted after the years of growth are completed than during those years. In laborious lives, the constant expenditure caused by muscular exercise may well nigh furnish carbon enough for the purposes of respiration from the expenditure of tissue, and the diet might, perhaps, consist almost exclusively of nitrogenised substances. An inactive life would have been almost impossible, without the aid of such food as ministers exclusively to the respiratory process; and man must have laboured not only for his pleasures, or for his daily sustenance, but for the expenditure of so much of his own frame-work as would furnish the carbon necessary to maintain the temperature of his body; and this would be still more the case, when, inadequately clothed and not warmly housed, his surface, at least in the colder latitudes, would be exposed to much and rapid loss of temperature, by day and night,—rendering a life of almost unceasing exertion, a necessity of existence. Thus, step by step, has man, in his successive generations, earned for himself the power of maintaining his elevated temperature, with longer intervals of repose and quiet,—the power of making his body subserve more and more the purposes of its great tenant,—the power of devoting life to intellectual pursuits, of expanding and elevating the nobler capabilities of his nature. It is indeed curious, and an abundant cause for wonder and gratitude, to contrast the barbarous inhabitant of the colder latitudes, living

chiefly on the animals he might slaughter in the chase, half clothed, and coldly housed,—passing all his waking hours in constant exertion, to procure the precarious means of his sustenance; and, even if the chance slaughter of some larger animal set him temporarily above the immediate pressure of want for some days or weeks, nevertheless compelling him, by his instincts, to continue his days of toil, for the maintenance of his bodily heat, by the adequate expenditure of tissue to furnish the carbon requisite for the consumption of the respired oxygen;—to contrast such a slave to the body's necessities, with civilised man,—raised above the pressure of want by agriculture,—sated with variety by commerce,—the temperature of his body largely preserved by abundant clothing and well-warmed houses,—his respiratory carbon supplied adequately by vegetable food,—his need of muscular exercise reduced to the question of expending what is necessary of the tissues, to make way for their timely repair and renewal,—and the large balance of his days of life left at his disposal, for the cultivation of his intellect, and the enlargement of his mental and physical resources, and the placing himself and his fellow men on still higher vantage ground, for the elevation and improvement of the moral and intellectual nature.

Milk seems, of all kinds of animal food, to be that which is the most natural, and the one that would therefore, *à priori*, strike the mind as being likely to be most easily digested. It does agree with the stomachs of most people; its use being attended

with only one inconvenience, and this does not by any means always obtain. It often constipates the bowels, and thus deranges the digestive processes. This is less likely to happen, if the milk is thickened with flour or oatmeal; and then it forms a diet which most people like, and which is very generally wholesome. Such addition, moreover, renders milk more easily digested. The beneficial effect of the flour, or the oatmeal, on the digestion of milk, is partly owing to the mere thickening,—the use of which in facilitating the digestion of liquid food has already been spoken of; but it acts chiefly by preventing milk from curdling in large masses in the stomach. Milk is curdled by the gastric juice before it is digested. The effect of the flour, or the oatmeal, is to separate the milk, and cause it to be curdled in small portions, instead of being formed into large masses of curd. The way in which this must add to the digestibility of milk, must be sufficiently obvious. A diet that is usually considered palatable, and which agrees well with those who can take milk in any form, is made of equal parts of skimmed milk and barley water; to which a little sugar or lemon-peel, either or both, forms a grateful and not unwholesome addition.

Milk is, of all kinds of food, the one which is the best adapted to children; and it should mainly constitute the principal meal,—which, at all ages, ought to be the breakfast.

Cream, the more oleaginous part of milk, which, from its lower specific gravity, spontaneously separates from milk, and rises to the surface when it has been allowed to remain at rest for some hours, consists of butter, casein, and whey. These several constituents of cream vary somewhat in their relative proportions: they are stated, on the authority of Berzelius, to be—butter $4\frac{1}{2}$, casein $3\frac{1}{2}$, and whey 92 per cent.

There is a saying very prevalent in Derbyshire, that "cream is lighter than milk;" implying that it does the stomach less harm, and is more easily digested, because it swims on the top of the milk. To whose strange abuse of the meaning of the word *light*, the public is indebted for the singular opinion, I do not know. If respectable for its antiquity, it certainly is so on no other account. If it were true, that the more specifically light the substance, the more easily it is digested, butter, or fat, or oil, would be more easily digested than would water. This would scarcely have been noticed at all, had it not been for the personal knowledge I have of its being so prevalent a notion in this county, and had I not seen repeated instances of its injurious consequences. Cream is, of course, much less digestible than milk.

Curd (casein) is separated from milk by the addition of acids; and it separates from it when milk undergoes spontaneous decomposition, or when the decomposition is accelerated by the addition of a ferment, or an organised and azotised matter which

is itself in a state of molecular movement, and in the act of undergoing decomposition. The casein of milk appears to be held in solution by means of an excess of potash. Milk presents an interesting example of the spontaneous decomposition of animal matter. When exposed to the air, the first change seems to take place in the casein; and from this it extends to the saccharine matter; the sugar is partially converted into lactic acid, by which the remainder of the casein is coagulated; the decomposition proceeds, and the sugar is at length entirely changed into lactic acid, &c.

According to Scherer, the analysis of casein, as obtained from fresh milk, is—carbon 54·825, hydrogen 7·153, nitrogen 15·628, oxygen and sulphur 22·394.

Curd is less easily digested than cream, and is much less digestible than whey, or than skimmed or unskimmed milk. Curd is, however, more easily digested than butter.

Whey, which is the remainder when the curd has been separated from milk, is usually an easily digested and grateful beverage. It still contains much of the saccharine matter of milk; but the greater part of the oleaginous matter, and most of the casein of the milk are separated from it. The sugar of milk is obtained from whey, by evaporation to the consistence of honey, and clarification. It presents crystals of brilliant whiteness.

Sugar of milk is a weak form of the saccharine principle: that is, it contains a larger proportion of

oxygen and hydrogen than cane sugar,—or, according to Dr. Prout's view, a larger proportion of component water. There are three principal varieties of the saccharine principle, all consisting exclusively of carbon, hydrogen, and oxygen. Of these, the strongest, or that which contains the smallest relative proportion of oxygen and hydrogen, is obtained from the sugar-cane; the weakest, or most aqueous, called grape-sugar, is obtained from grapes, from honey, and, by the action of diastase, from starch; and the sugar of milk occupies a place between these. Its composition, according to Dr. Prout, is—carbon 40, hydrogen 6·66, and oxygen 53·34,—or 40 of carbon to 60 of component water.

Deprived of the casein, and of much of the oil, whey contains only the more digestible form of carbonaceous aliment obtainable from milk,—and even this in very small proportion; and is therefore properly considered as a beverage, rather than as an article of diet. It is not, however, by any means always easily digested by the feeble or dyspeptic stomach, and is not so frequently ordered as it used to be as a diet-drink for the sick. In the many cases of valetudinarianism where it agrees, it is, however, a valuable addition to the comforts and resources of the invalid, and is often quite worth remembering among the things to be suggested. It should be borne in mind, that the form of the saccharine principle contained in milk, from being of weaker character, is probably much more easily digested than that obtained from the sugar-cane.

Butter-milk, which is sometimes looked upon as little else than whey, is, however, very different in its nature and composition. It contains the greater part of the casein and the saccharine matter of the milk; the oily matter being in great part separated. It rapidly undergoes the acescent fermentation, and then may form an objectionable kind of food, or otherwise, according to circumstances. In any condition, however, it is a very nutritious article of diet, and is duly appreciated as such by the peasantry in Scotland, and the northern counties of England.

Skimmed milk, deprived as it is of the greater part of the cream, is undoubtedly more easily digested than unskimmed milk. Being only deprived of the oleaginous matter, and still containing the sugar and casein, skimmed milk is not so much less nutritious than unskimmed milk, as has been commonly supposed.

It is probably quite true, that, in most cases, the digestibility of milk is increased by boiling; but, admitting this to be the general rule, there will be found to be many exceptions to it. The scum which rises to the surface when milk is boiled, is said to consist chiefly of the alkaline and earthy salts, of which milk contains a varying proportion of from 2 to 7 parts in a thousand.

When the digestion of milk occasions flatulence and acidity, while its use seems to be otherwise strongly indicated, the addition of a small quantity of lime-water, in the proportion of half an ounce

to the pint of milk, often corrects the deranging tendency sufficiently well, and may form a useful suggestion.

The cases in which a milk-diet is indicated, and when not inconveniencing the digestive organs proves most useful, are of frequent occurrence, including a large number of scrofulous affections, and other conditions marked by a mixed state of debility and morbid sensitiveness; and accordingly, the consideration of a milk-diet forms one of the most important practical matters the medical man has to deal with. In a very large proportion of the cases of early phthisis, and in no small number of the cases of confirmed and even advanced phthisis,—in most of the cases of enlarged glands,—in most of the cases of spinal curvature,—in a large number of the cases of cachectic affection of the joints,—and in many of the cases of articular rheumatism of chronic character,—a milk-diet, more or less exclusively adhered to, constitutes a very important part of the treatment, and one that I believe to have been of late years far too much neglected. A milk-diet includes the addition of any of the simpler farinaceous aliments, as rice, sago, arrow-root, and bread; but a strictly milk-diet does not include any other form of animal food than the milk itself, nor does it include any of the stimulating products of fermentation.

What is meant by a milk-diet, may be illustrated from the diet-tables of the public hospitals. The diet-table of the Middlesex Hospital specifies, under

the head of milk-diet, as the daily allowance to every patient,—

12 oz. of bread	Daily.
1 pint of milk	For breakfast.
½ pint of milk, with rice-pudding four days, and with batter-pudding three days	For dinner.
½ pint of milk, or 1 pint of gruel	For supper.

The diet-table of the Manchester Royal Infirmary, under the same head, specifies—

1 pint of tea 6 oz. of bread ¾ oz. of butter	For breakfast.
½ pint of milk 12 oz. farinaceous pudding, bread, sago, arrow-root, rice, tapioca, or batter pudding, sweetened	For dinner.
1 pint of milk pottage 6 oz. of bread	For supper.

The diet-table of the General Infirmary, at Northampton, specifies, under the head of milk-diet,—

1 pint of milk porridge	For breakfast.
1 pint of thickened milk	For dinner.
1 pint of milk	For supper.
7 oz. of bread	Daily.

It will be sufficient to have quoted the above, as illustrations of a milk diet. The daily allowance of milk varies from 1½ pint (Manchester), to 3 pints (Northampton); the allowance of farinaceous aliment being proportionably less in the latter case. Containing from 16 to 19 ounces of alimentary matter, offered in a form that is in most cases very readily assimilated, such a diet as is presented in any of the above tables, may probably be considered equal to

maintain the powers of the system in due vigour, if not adhered to for a protracted period of time, and if not used under circumstances of active and continued exertion. It is proved, at all events, to be equal to the support of the system under most such invalided conditions, as a rigid adherence to a milk-diet, during some weeks or months, would be likely to benefit.

According to the analysis already quoted, 1000 parts of cows' milk contain:—water 857, butter 40, casein 72, sugar and extractive matter 28. The same authority (J. F. Simon) states, that an analysis of asses' milk afforded:—water 907,—butter, with some lactic acid, 12·10,—casein 16·74,—sugar, with extractive matter and alkaline salts, 62·31.

Cows' milk may be said, in round numbers, to contain 4 per cent. of butter, 7 per cent. of casein, and 3 per cent. of sugar. Asses' milk appears to contain less than a third of the proportion of butter, less than one-fourth the proportion of casein, and more than double the quantity of sugar, compared with the proportion of these ingredients in cows' milk. It is easily explained from this, that asses' milk is more easily digested, and less nourishing, than cows' milk. The usefulness of asses' milk in the case of many invalids, so long known and believed, and which has of late years been comparatively little attended to, is demonstrated satisfactorily by the results of the analysis, and deserves to be insisted on. The analyses of goats' milk afford results, as to the relative proportion of butter, casein, and sugar, contained in it,

which are too far different from one another to justify any inferences, as to its relative nutritiousness and digestibility, that might be derived from them. But goats' milk contains a peculiar animal matter (Hircic acid), of strong taste and odour, which seems to be apt to derange the digestive organs, and might render goats' milk unfit for the diet of the invalided. This is of little importance in this country, as regards the dietetic question of milk; but it bears on the question of cheese made from it, which is imported, and has come to be a good deal used.

As a question of some physiological interest, it may be noticed, that, compared with cows' milk, human milk is said to contain little more than half the quantity of butter, not so much as half the proportion of casein, and not very much less than double the proportion of saccharine matter.

By agitation (churning), as is well known, the butter is readily separated from the cream. Butter is, strictly speaking, a mixture of the oleaginous matter of milk with a portion of casein and whey. These may be separated from the oily part by heating the butter to the temperature of 98°; but the characteristic flavour is thereby in a great degree lost, and the probable digestibility considerably affected. It may be said to be no longer butter, but the pure oleaginous matter of milk; it is almost transparent; and its tendency to undergo spontaneous decomposition is diminished in the same proportion as it is freed from azotised matter.

Butter is admitted, on all hands, to be irritating

to the stomaeh of the dyspeptic, and to be with diffieulty digested, and therefore a common cause of derangement, in the ease of most invalids. If eaten at all by sueh persons, it should be used sparingly and eold. Melted butter, whether on toast or in sauees, should be banished from the table of every valetudinarian. The digestibility of butter depends, moreover, very much on its freshness and quality. The less reeently it has been made, the less easily is it digested; the less earefully it is separated from the butter-milk, the more apt it is to disagree with the stomach. A eow fed on fresh herbage, yields a better and more easily digested butter, than the animal which is stall-fed; and this is still more the ease, if the eomparison be made with butter from a eow fed on oil-eake, and strong or rank food. Salt butter, however carefully made and preserved, if kept for some time, is necessarily mueh less easily digcsted than fresh butter of good quality. The addition of a certain quantity of salt to butter at the time of eating it, promotes, however, its digestion, as in the ease of the other oleaginous artieles of food. It should be borne in mind, that butter and other oily artieles of diet have, vcry generally, more or less of solvent effcet on the bowels; and that in some eases, this may prove a rcason for allowing such articles to form part of the diet, where its propriety might otherwise be doubtful, or in whieh it might be otherwisc properly forbiddcn.

It may be reasonably doubtcd, whether children,

and especially very young children, should be allowed to eat butter. Indeed, childhood is the age at which a rigorous attention to dietetics is often most imperatively called for, both as the means of warding off the diseases of early life, and mitigating their severity when they do occur, and as the means of laying a foundation for temperance and self-control in their after-life. Yet the opposite extreme of making the lives of children a series of needless daily penances, should be carefully avoided. Carried to an unreasonable extent, such restrictions may only serve to debilitate the system generally, and weaken the digestive organs; while it may debase, cramp, and irritate their moral and intellectual nature, and thus lead, more or less directly, to eventual consequences that are no less deplorable. It is a matter of some nicety and much importance in the management of children, to restrict the diet, as far as is needful for their physical well-being, and as far as may conduce to the rearing of a well-regulated mind, endowed with self-control, —and by no means to the extent of debilitating the powers of the body, or cramping the faculties of the mind. Such questions should always be brought before the child's mind, as matters of reasonableness and judicious guidance, rather than enjoined as so many motiveless penances.

Cheese,—or casein, dried, and having probably undergone some chemical change in the year or two allotted to what is called the *ripening*,—is generally very difficult of digestion. Cheese almost

always contains a considerable proportion of the oleaginous part of the milk mixed with the casein. In some cases, the cheese is made almost entirely from cream, and contains a correspondingly large proportion of butter. The comparative impunity with which many persons can eat toasted cheese, may be partly attributed to the mustard, &c., usually taken with it; although the cooking has much to do with the greater digestibility.

It is difficult to over-estimate the effect of cookery in the digestion of the different articles of food. It is probably the chief cause of the usually much greater digestibility of toasted cheese; it influences the digestion of milk; it modifies in a material degree the digestion of animal fibre, and is in many cases all-important, as will be hereafter stated, in the digestion of fecula. In the case of the more albuminous substances, as in that of animal fibre, the digestibility is impaired, or otherwise, according to the degree of heat to which the article of food is exposed. Although exposed to a much higher temperature when roasted than when boiled, meat cooked in the former way has been determined to be much more easily digested than boiled meat; but to this should be added, that meat cooked in water seems to be more easily digested, if the water be maintained at the simmering temperature of 120° to 150°, than if allowed to reach the boiling point of 212°; that roasted meat becomes less easily digested if cooked before a very hot fire; and that, whereas dissolved animal fibre may be usually more easily digested

than solid fibre, animal fibre is not digestible in the ratio of its solubility,—since veal and lamb are less easily digested than beef and mutton; and this, even if all the fat is, in either case, most carefully removed, and the meat cooked in any way, and at any temperature. The reducing effects of cookery, in a mechanical point of view, are of much importance in facilitating the action of the digestive organs on the food; but its reducing effects in a chemical point of view,—causing the alimentary matters to become blended, if not actually combined, with a larger proportion of water,—is usually of still greater importance, and especially in the instance of many of the vegetable articles of food.

The question as to the digestibility of cheese, is by no means confined to that of its solubility in the gastric secretions, or its passage into the upper bowels. Cheese is apt to produce crudity, and consequent irritation, in the intestines, and to affect the functions of the abdominal viscera,—sometimes inducing a relaxed, but more frequently a costive, state of the bowels; and it may be on these accounts sufficiently objectionable, supposing that its primary digestion may occasion no inconvenience. Cheese made from cows' milk is more easily digested than that made from goats' milk; and the richer, or more oleaginous, the cheese, the more easily is it digested. There is no doubt that perfectly ripe, or well-matured cheese, is much more digestible than new cheese, whatever may be the opinion regarding the digestibility of decayed

cheese. The truth seems to be, that, inasmuch as decayed cheese is much more stimulating than ordinary cheese, although in many cases it irritates and disturbs, it often in other cases appears to assist a weakened stomach in the digestion of its food. But decayed cheese usually irritates the dyspeptic stomach,—in which there is either morbid sensibility of the organ, or an acrid state of the gastric secretions, or both; and it cannot, of course, be more than a temporary stimulus to the stomach, which effect might, if such were thought to be advisable, be obtained by some other means, less liable to possible objection on account of the difficulty of ultimately assimilating a concentrated or undiluted alimentary substance into blood.

There can be no doubt, as has been well and ably shown by Dr. Prout, that the digestibility of many substances is much impaired by their being offered to the stomach in a concentrated form;—that honey, inasmuch as it is a weaker form of sugar, is by so much more easily assimilated than pure sugar;—that cream, or butter, when taken in the natural state of milk, are much less objectionable and injurious to the stomach, and task less the assimilating powers of the system, than when taken in the separated and concentrated form;—that pure albumen, or pure gelatin, or pure fibrin, is perhaps in every case less easily assimilated, than when in the state of natural dilution in which they severally exist in the ordinary articles of food;—that starch is more easily assimilated, even if it be not more

easily converted into chyme by the stomach, when diluted with vegetable fibrin (gluten) in the flour of the different grains, than when separated, and taken in the purer state. And hence it may be conceived, that arrow-root, although so similar in composition to the starch obtained from wheaten flour or from potatoes, may be more easily assimilated, because diluted with a small proportion of some other vegetable and aqueous matters; and hence it may be inferred, that a common practice of mixing pure vegetable fibrin with the food of children,—obtaining the fibrin by boiling flour inclosed in a bag for a long time in water, thus extracting the starch, &c., and leaving the gluten as a hard lump in the bag, taking it out, scraping it into powder, and mixing it with the child's food, —although it may be occasionally indicated, will seldom be without serious objections, even on the score of digestibility; and that, when fibrinous matters are strongly indicated by the evident wants of the child's system, it might be better to supply it in the diluted and mixed state of animal fibrin, either in the form of gravy, or of animal fibre.

Cream-cheese, and particularly when used in a state of partial putrescence, as is commonly the case, is even less digestible than ordinary cheese, especially when the latter is perfectly ripe. When quite fresh and free from taint, however, cream-cheese is probably as digestible as other cheese; but, —however free from taint or rancidity,—and however rich or oleaginous, and by so much more digestible,

—cream-cheese is, nevertheless, mainly composed of casein, and is by so much less digestible than butter.

The egg constitutes an important feature in every cookery-book, and is little less important in a work on diet. Both the yolk and the white are principally albuminous: the latter is almost purely albuminous; in the former an oily substance is added to the albumen.* Notwithstanding this—and it may be in part as a consequence of the oil it contains, diluting in so far the pure albumen—the yolk very generally suits the dyspeptic stomach. If lightly boiled, the digestion of the yolk of egg is hardly ever felt. Not so the white: when boiled, this almost always irritates the disordered stomach; and by the dyspeptic and invalid it should not be eaten. The same observations apply, to some extent, to eggs when made to form part of a pudding: the yolk is still the part which is most easily digested,—the white, that which is the more likely to disagree; but the latter is not so likely to prove injurious, as when eaten alone, and unmixed with other things. The probable reason of this is the same as that assigned for the increased digestibility of milk, when mixed with flour or oatmeal: the albumen being prevented from coagulating into large masses, is offered to the action of the gastric secretions in smaller portions, which are therefore

* "Of an egg weighing 1000 grains, the shell constitutes about 106 grains, the white 604, and the yolk 290, or thereabouts. * * * * In one instance, the yolk, weighing 316·5 grains, contained 170·2 water, 55·3 albumen, and 91 yellow oil; but these proportions varied in different instances."—*Dr. Henry's Elements of Chemistry.*

more readily acted upon by it. It is an important fact, that either the white or the yolk of egg, if eaten raw, and therefore uncoagulated, is very much more easily digested than when it has been previously boiled. The albumen is, of course, in this case coagulated by the acid secretion of the stomach, as the first step to its digestion; but this coagulation is different from the coagulation by heat, and does not offer the same degree of resistance to the solvent powers of the stomach. A raw egg is not, then, liable to the objections, on account of its degree of digestibility, that a boiled egg may deserve; and on the contrary, it would seem that there are few articles of diet which are so quickly or so easily digested as uncoagulated albumen. Lightly poached egg is probably more digestible than egg boiled in the shell; and this may be owing to the more rapid coagulation of the albumen, and the shorter time it is necessary to expose the albumen to the heat, in order to render it sufficiently cooked for palatability. It is hardly necessary to say, that fried eggs, involving the addition of fat, part of which is necessarily browned, and by so much burned or converted into empyreumatic oil, and likewise involving the exposure of the albumen to a much higher temperature than that of boiling water, must be much less easily digested than boiled eggs. Hard-boiled egg is very slowly digested. But, however objectionable on this account to the dyspeptic, it constitutes to the strong and healthy a substantial article of food,—keep-

ing away the sensc of hunger for a considerable time, together with the feeling of faintness and exhaustion so apt to attcnd unappeased hunger; and thus, this has long been a favourite artiele of food for people who have, for many sueeessive hours, to undergo eontinued exercise,—as sportsmen and others. As in the ease of most artieles of food, and especially when offered in the simpler forms, the addition of salt promotes very much the digestibility of egg,—and the addition of butter interferes with its digestion.

The white of egg is, upon an average, of about twice the weight of the yolk. Deducting from the weight of the egg about one-tenth part for the weight of the shell, and the half of remaining nine-tenths for water, and less than a fourth of the further remainder for the oleaginous matter of the yolk, the large proportion of about one-third of the entire egg appears to consist of azotised matter; and the egg, usually digested without any diffieulty, is no doubt eapable of ministering in a eorrespondingly considerable degrec to thc nutrition of the body.*

The digestibility of cgg is mueh influenced by its having been reecntly laid. Containing so much azotised mattcr, and the usual proportion of sulphur and phosphorus, cgg soon undergoes thc changes of decomposition; and probably to a eonsiderable ex-

* The hen's cgg is, of eoursc, exelusively referred to in the text. The eggs of the duek and the goose are mueh less easily digested. The cggs of somc of the wild birds, particularly the plover, are estcemed as gastronomic delieacies. They do not differ from the hen's egg as to digestibility, in any very appreeiable degree.

tent before these are to be detected by the taste or smell. The ultimate composition of albumen, on the authority of Mulder, is—carbon 54·84, hydrogen 7·09, nitrogen 15·83, oxygen 21·23, sulphur, 0·68, phosphorus 0·33.

The vegetable substances that are used as food, differ essentially from the animal articles of diet, in containing a large dilution of starch or of sugar, which embrace the purposes of respiration, and do not minister to the nutrition of the body;—the nutrient parts of the vegetable articles of diet being either vegetable fibrin, albumen, or casein, which exist in them in different proportions;—these vegetable principles being azotised, as the same principles are when derived from animal substances, and being like them convertible into protein, and therefore, according to MM. Mulder and Liebig, capable of being assimilated by the organism, and converted into tissue.* In most cases, the azotised principles are

* "Such are vegetable albumen, vegetable fibrin, and vegetable casein, as well as animal albumen, animal fibrin, and animal casein. The latter, when compared with the former respectively, are found to differ from them only in form, agreeing with them in all essential chemical characters. Every one of the six dissolves in strong hydrochloric acid, gently warmed, with a purple colour; and all of them likewise dissolve in caustic potash, forming a solution which (after all the sulphur has been converted into sulphuret of potassium by boiling) gives, on the addition of acetic acid, sulphuretted hydrogen gas, and a gelatinous (looking) precipitate, which in every case is the same substance, called *protein*, by Mulder its discoverer. Hence the above substances are called *protein compounds*,—not that we can prove them to contain protein ready formed, but because they all yield protein in the same circumstances."—*Outlines of Chemistry*, by Dr. William Gregory, Professor of Chemistry in the University of Edinburgh.

further diluted, or *reduced*, by containing, in large proportion, either water or its elements, and being thus made to constitute a weaker form of alimentary matter. Vegetable fibrin, or gluten, is readily obtained separately from the flour of wheat; and is contained, in greater or less proportion, in that of most of the other more important grains. It is the gluten which remains in the hand when wheaten flour is kneaded under water, and the starch separated from it by this means. It is not, however, as was once thought, the binding element, which enables the flour to be formed into a paste; but this property, seemingly possessed by it, in the case of wheaten flour particularly, is due, according to modern chemists, to another substance, which is combined with it in small proportion. Vegetable fibrin must evidently be dissolved in the juices of the plant, as the fibrin of the blood is soluble in that fluid; although both are separable from the solvent by simple mechanical means, and although it is insoluble in water. The second azotised constituent of vegetables, in point of dietetic importance, is albumen, which is almost identical with animal albumen, as found, for instance, in the white of egg. Like it, this is coagulable by heat, and is, by this means, readily separable from the juices of many vegetables, as cauliflower, asparagus, or turnips,—being likewise abundant in certain seeds, as nuts or almonds (Liebig.) Vegetable casein, the third form of azotised nutriment found in vegetables, is soluble in water, but is not coagu-

lated by heat. When an acid is added to it, however, it coagulates, exactly as animal milk does,—the curd, or casein, separating from the fluid. This is found chiefly in the leguminous seeds, as peas or beans. By reason of one or more of these being contained in the different vegetable substances, they are nutritious; being, of course, more nutritious, other things being equal, the more of these azotised substances convertible into protein that they contain, and the less the degree of their dilution, by starch, or other non-azotised matters.

There is said to be no difference of composition between animal and vegetable fibrin and albumen; and these vegetable principles are therefore directly fitted for assimilation and conversion into the animal organism.

The grains owe their great power as nutrient aliment to the large proportion of albuminous matter which they contain; much diluted, however, as this is, in all cases, with starch.

GRAIN.

1. Wheat-flour.	4. Maize-flour.
2. Rice.	5. Oatmeal.
3. Rye-flour.	6. Barley-meal.

7. Peas meal.

Of these, only the three first are much used in England; the fourth having been hitherto principally used in America; and the three last having been, as far as Great Britain is concerned, chiefly confined to the north of the Tweed.

The wheat grown in the southern counties of England usually contains a larger proportion of albuminous matter than that grown in the northern part of the island; and the character of the season as to temperature, &c., the amount of tillage, and the nature of the soil, not only influence the amount, but likewise affect the nutritive quality, of the produce. But the wheat grown in certain parts of the South of Europe is pre-eminently distinguished by the large proportion of gluten contained in it.

It used to be said, that in the flour of the best wheat that is grown in this country, there is from 18 to 24 per cent. of gluten (fibrin); whereas in that of oats, there is only six per cent.; in that of rye, only five per cent.; and in that of peas, only four per cent. It is to be borne in mind, however, that this presupposes that the amount of the binding element of the flour represents fairly the proportion of gluten with which it is connected,—and this leads to an opinion that is by no means correct. And, again, there is no doubt, that, in many cases, as in the cited case of peas, the diminished proportion of gluten is made up for by the presence of a much larger proportion of one of the other azotised constituents, that are, like it, convertible into protein. It is said, for instance, that maize flour contains very little, if any, of the binding constituent; and inferences in depreciation of its nutritiveness have been attempted to be drawn from it, which facts sufficiently disprove; and, further, the inquiries which might seem to show that oatmeal is only one-fourth

as nourishing as wheaten flour, might be objected to on the commonest observation, as by no means representing adequately the nutritive qualities of oatmeal. The amount of gluten separable from the flour of any grain by kneading it under water, by no means represents the relative nutritiveness of the flour when used as food, unless in the ease of wheaten flour. It may serve to distinguish a better from an inferior sample of wheaten flour.

A more eorreet view of the comparative amount of albuminous or azotised matter eontained in the different grains, &e., is given in the following table, for whieh we are indebted to the work of Dr. R. D. Thomson, on the food of animals * :—

	Albuminous or Nutritive Matter, per cent.
Bean meal	25·36
Linseed meal	23·62
Scotch oat meal	15·61
Semolina	12·81
Canadian flour	11·62
Barley	11·31
Maize	10·93
Essex flour	10·55 to 11·80
East Lothian flour	9·74 to 11·55
Hay	9·71
Malt	8·71
Rice (East Indian)	8·37
Sago	3·33
South Sea arrow-root	3·21
Tapioca	3·13
Potatoes	2·23
Starch (wheat)	2·18
Swedish turnips	1·32

* Experimental Researches on the Food of Animals, and the Fattening of Cattle, with Remarks on the Food of Man. By Robert Dundas Thomson, M.D., Lecturer on Practical Chemistry, University of Glasgow.

It is, of course, to be understood, that this comprises all the azotised alimentary matter obtained from these substances, whether in the form of vegetable fibrin, true albumen, or casein. This will serve to explain how it happened that the older chemists arrived at the opinion, now proved to be erroneous, that wheaten flour is more nutritious than that of the other alimentary seeds and grains: since, in the first place, they conceived the amount of the binding principle contained in the flour to represent the proportion of azotised matter contained in it; and, in the second place, they estimated the amount of vegetable fibrin, without taking notice of the two other azotised principles, although these minister, and probably in an equal degree, to the nutrition of the body. Bearing these observations in mind,—they will have to be noticed in more detail, however, from time to time,—the table gives a very interesting view of the proportion per cent. of azotised matter contained in the different substances enumerated. But it by no means follows, that the different substances should be more or less nutritious in exactly the same degree; although it may give results, as to this, which approximate to the truth. Much depends on the digestibility of the form in which the azotised matter is presented to the digestive organs. The table affords a strong illustration of this in the case of hay; the number attached to which would, assuredly, not represent its power of affording nourishment to the human system. The different articles of the table contain, moreover, an average

of from 10 to 14 per cent. of water; the large remainder, with a small deduction of saline matters, consisting of what are called calorifiant matters,—that is, substances which subserve exclusively the purposes of respiration, and to maintain the animal heat, as starch and sugar.

It is, in truth, quite impossible to arrive at any definite, or otherwise than approximative results, from the analytical operations of chemistry, as to the amount of nutriment contained in a given quantity or weight of any of the articles of food. It may indeed be said, with sufficient certainty, that the non-azotised aliments only minister to the respiratory process, and are not otherwise alimentary; but it cannot be maintained that substances are nutritious in a definite proportion to the amount of albuminous matter they contain. This is particularly remarkable when animal food is compared with vegetable food, the relative proportion of albuminous matter contained in different animal and vegetable substances ascertained, and these are considered with distinct reference to their nutrient powers. "When the muscular parts of animals are washed repeatedly in cold water, the fibrous matter which remains consists chiefly of albumen, and is in its chemical properties analogous to the clot of blood. Muscles also yield a portion of gelatin; and the flesh of beef, and some other parts of animals, afford a peculiar substance, of an aromatic flavour, called by Thenard, *osmazome*. Albumen and gelatin constitute the leading nutritive ingredients in the different kinds of flesh used as

food, and it is curious that their relative proportions are not very dissimilar in quadrupeds, birds, and fishes, as shown in the following table. The water was determined by evaporation in vacuo, or at a temperature below 212°.

100 Parts of Muscle of	Water.	Albumen, or Fibrin.	Gelatin.	Total of Nutritive Matter.
Beef	74	20	6	26
Veal	75	19	6	25
Mutton	71	22	7	29
Pork	76	19	5	24
Chicken	73	20	7	27
Cod	79	14	7	21
Haddock	82	13	5	18
Sole	79	15	6	21

Professor Brande's Manual of Chemistry.

If the different articles of this table are compared with one another, the relative nutrimentary matter ascertained by the chemist, and the relative power of affording nourishment to the system ascertained by observation and experience, will be found to be very different. The relative difficulty with which fish is so often found to be digested, might possibly be referred to the larger quantity of water mixed with the albuminous matter; and the proportions of 18 per cent. of albumen and gelatin contained in haddock, and 29 per cent. of these azotised substances contained in mutton, might assist in determining the relative nutritive qualities of these substances; but no such results of chemical investigation would justify an inference that chicken is more nutritive than beef, or pork less nutritive than veal. As has been said before, it is only in the general principles, and not in the minuter details, that chemical experi-

ments have assisted dietetic inquiry. If an article of food does not contain azote, it may be inferred that it can only minister to the respiratory process; and in many instances, as in the case of fat, and in that of milk and its different products, this serves a very important purpose in estimating the dietetic uses and value; but such experimental results do not enable us to arrive at any definite conclusions, as to the amount of respiratory or of nutrient matter which the digestive organs may extract and assimilate from any dietetic substances; although, if all other circumstances are the same, it may assist us in arriving at a probable conclusion. For instance, it is certainly true that, in man, and *à fortiori* in strictly carnivorous animals, animal food is capable of affording a larger amount of nutrimentary matter to the system than vegetable food. No statement that bean-meal or linseed-meal contains more albuminous matter than beef or mutton, would justify an inference that they are therefore more nutritive articles for the food of man. The character and peculiarities of the organs of assimilation must be taken into the account; and the results of chemical experiments, the peculiar nature of the digestive organs, and general experience and observation, must serve to confirm and strengthen one another, or, in a practical point of view, the researches of the chemist are of little value in dietetic details.

One great point of difference between the different articles of food, consists in the proportional amount of blended or combined water which they respectively

contain; and one of the most important of the uses of cookery is to adjust, and in some degree equalise, the condition of the several alimentary substances as to this matter. Animal food contains, in the first instance, as much combined water as is commonly required for the purposes of the primary assimilation; and the uses of the economy are sufficiently answered, by taking any additional aqueous matter that may be required, either at the meal times, or at other periods of the day. Indeed, the modes in which meat is often cooked, necessitate the removal from the meat of a considerable proportion of the aqueous matters; the animal fibre not seeming to be thereby rendered in any very apparent degree less digestible, provided this desiccating process is not carried too far. Such food is inferred from the table, to contain usually 74 per cent. of water. In the case of vegetable food, the proportional of combined water varies very much, from the maximum quantity contained in many of the fruits, roots, and succulent plants, to the minimum contained in the flour of the more important grains. In this latter case, cookery subserves a very important purpose in adding to the proportion of combined water, chemically reducing or lowering the definite proportion of carbon and nitrogen contained in the alimentary substance, and adding to its proportionals of oxygen and hydrogen.

Aliments are, then, diluted with a larger or smaller proportion of combined water, as well as by admixture with the non-azotised alimentary substances; and

on the relative proportion of such dilution, as well as on the amount of proportional azote, and on the mechanical condition of the food, &c., do the due assimilation, and the relative nutritive properties of the different aliments, in some degree, depend.

According to the climate in which wheat is grown, the favourable or unfavourable nature of the season, the greater or less degree of cultivation bestowed upon the soil, &c., does wheat contain more or less gluten; and although it is not, strictly speaking, to the gluten, but to the admixture of the gluten with another principle (gliadine), that flour owes its viscidity when mixed with water, yet as this must bear some proportion to the quantity of gluten contained in the flour, the dough is necessarily more tenacious, the larger the proportion of gluten contained in the flour from which it is made.

It is, then, the vegetable fibrin which is the principal nutrimentary ingredient of wheaten flour; this being *diluted*, so to speak, with starch, which subserves exclusively the purposes of respiration*; and the degree of viscidity of the dough made from the flour, is, to

* The needfulness and effect of the dilution of the azotised articles of food by means of the non-azotised, is well illustrated in the following passage from Mr. Darwin's admirable Journal:—Journal of Researches into the Natural History and Geology of the Countries visited during the Voyage of H.M.S. Beagle round the World. By Charles Darwin, M.A., F.R.S. The author is on his way from Bahia Blanca to Buenos Ayres. "We were here able to buy some biscuit. I had now been several days without tasting anything besides meat: I did not at all dislike this new regimen; but I felt as if it would only have agreed with me with hard exercise. I have heard that patients in England, when desired to confine themselves exclu-

somc extcnt, a criterion of the proportion of azotised matter contained in it, and eonsequcntly of its comparative excellcnee. Hencc it happens, moreover, that the best flour—that whieh contains most gluten, always makes the lightest bread, by preventing, in somc degree, the escape of the produets of the fermentation, to whieh proeess most of the bread that is eaten in the present day is subjected before it is baked. Thc two principal varieties of bread are, that whieh is leavened, or has undergone some degree of fermentation, and that whieh is unleavened.

Thc charaeter of the flour is a good deal altered by the fermentation. A large quantity of the carbon unites with oxygen, and is evolved as carbonie aeid. A small quantity of acetic acid is likewise generated, whieh, together with the earbonic aeid, is in a great measure expelled by the heat during the proeess of baking. A considerable quantity of alcohol has,

sively to an animal diet, even with the hope of life before their eyes, have hardly been able to endure it. Yet the Gaueho, in the Pampas, for months together touehes nothing but beef. But they eat, I observe, a very large proportion of fat, whieh is of a less animalised nature ; and they partieularly dislike dry meat, sueh as that of the Agouti. Dr. Riehardson also has remarked (Fauna Boreali-Americana, vol. i. p. 35), "that when people have fed for a long time solely upon lean animal food, the desire for fat beeomes so insatiable, that they can consume a large quantity of unmixed and even oily fat without nausea :" this appears to me a eurious physiologieal fact. It is, perhaps, from their meat regimen that the Gauehos, like other carnivorous animals, ean abstain long from food. I was told that at Taudeel some troops voluntarily pursued a party of Indians for three days, without eating or drinking." It need hardly be said, that, supposing the digestive organs to be equal to the task of its assimilation, the fat would be as much a diluent to fibrinous and azotised flesh, as stareh is to the albuminous matter of wheaten flour.

moreover, been obtained from a batch of bread while baking. The addition of yeast, or leaven, to the paste or dough, and the fermentation of the mass, are not then to be regarded merely as means of adding to the palatability of bread, but as materially altering its character. A larger or smaller proportion of the flour is virtually lost. Flour contains about 5 per cent. of saccharine matter, and this appears to be wholly expended during the panary fermentation. In addition to this, it is probable that a portion of the starch is made use of, in the formation of the various products of the fermentation; and there is little doubt that, to some extent, the more important fibrinous and azotised constituent of the flour is expended, to multiply the particles undergoing the molecular changes that constitute the necessary condition of the fermentative process, since it seems that a yeast or ferment consists essentially of an azotised substance in a state of decomposition. Additional ferment is thus obtained from a partial decomposition of the gluten of the flour; and the action becomes extended throughout the whole batch of dough, at the expense of a corresponding diminution of its azotised and nutritive properties. This loss of the elements of flour during the panary fermentation, amounts, according to Dr. William Gregory, to the very large proportion of one-sixteenth part of the whole of the flour (Op. Citat. p. 532). He says, "To avoid this loss, bread is now raised by means of carbonate of soda or ammonia and

a diluted acid, which are added to the dough, and the effect is perfectly satisfactory. Equally good or better bread is obtained, and the quantity of flour which will yield 1500 loaves by fermentation, furnishes 1600 by the new method, the sugar and fibrin being saved." Another authority, Dr. R. D. Thomson (Op. Citat. p. 183), says, "The result of my experiments upon the bread produced by the action of hydrochloric acid upon carbonate of soda, has been, that in a sack of flour there was a difference in favour of the unfermented bread to the amount of 30 lbs. 13 ozs., or, in round numbers, a sack of flour would produce 107 loaves of unfermented bread, and only 100 loaves of fermented bread of the same weight. Hence it appears, that in the sack of flour, by the common process of baking, seven loaves, or six and a half per cent. of the flour, are driven into the air and lost." * These opinions confirm one another, as to the degree to which the flour loses its non-azotised and its azotised constituents during the fermentation of dough. So far as the processes of digestion are affected, the result of the fermentation is probably only of importance,

* Were it to become a universal practice, to render bread porous and light by the chemical re-action of acids and the carbonated alkalies, some of the observations in the text would become unnecessary. But, in the first place, people are not readily led to adopt fresh processes in their domestic economy; and, in the next place, the success of the experiments demands a degree of care and accuracy, as to the strength of the acid made use of, and such a careful adjustment of the respective qualities and quantities of acid and alkali, as could rarely be obtained in private houses, or even among professed bakers.

inasmuch as the gaseous matters, generated by the fermentation, and prevented from making their immediate escape by the viscidity of the dough, render the bread light, or spongy, producing a number of cells in it, by which a larger surface for the escape of the watery and other matters is produced; by which, moreover, the heat more readily and quickly permeates its substance, and more thoroughly cooks it; and by which it would seem to be more readily dissolved by the gastric juice. But, although the fermentation of bread is attended with such considerable advantages, yet it makes necessary an extra degree of care, as to the bread being very thoroughly baked, and it makes it of some importance that the bread should be kept for a day or two before it is eaten. If not thoroughly baked, not only does part of the bread remain in the state of dough, viscid and tenacious, and but ill-suited to the solvent action of the stomach; but not having been completely freed from its fermenting ingredients, the process will probably be continued in the stomach, and interfere much with its functions. The same thing is, although to a much smaller extent, applicable to new bread. Some little time is necessary, after the bread is baked, for the escape of the gases, that have been generated by the fermentation, and disengaged by the heat; and this is perhaps still more necessary, to allow the watery matters to evaporate in some degree; and the bread is left drier, purer, and more wholesome. The crust and the part of the bread next to it are much more easily digested than the inner part of the loaf; and this,

probably, because from the former the products of fermentation have been more completely expelled. But another remark should go hand in hand with this: the browner the crust, the more have the nutritious elements of the bread been altered, or driven off, by the heat, and the greater the proportion of charcoal in what remains.

It is a sound dietetic observation, then, that bread, if wished to be as easily digested as possible, should be baked in small loaves. The principal reason for this, as may be gathered from what has been said, is, that the bread is in this way more entirely freed from the products of fermentation: they must escape more completely from a small loaf than from a large one. There is, moreover, in the second place, less necessity for putting the bread into a very hot oven, or for keeping it in the oven so long a time as to deprive the outer part of its nutritive qualities. Bread baked in small loaves is sweeter to the taste than when baked in large loaves; and this is probably because it is more entirely freed from the products of fermentation. To the same cause may probably be referred, the greater digestibility of toasted than of untoasted bread; the bread being, in this way, not only dried, but the fermented matters being to a great degree expelled,—and more particularly if the bread be cut in very thin slices, and toasted before a hot fire.

The degree to which the fermentation of the dough is carried before it is put into the oven, likewise affects its digestibility. If the fermentation of the

dough be carried far, whether for the sake of increasing the apparent quantity of the batch of bread, or to render the bread whiter, or for any other purpose, there is no doubt that not only is the amount of alimentary matter by so much diminished, but the digestibility of the bread is lessened in the same proportion. Such bread will have undergone so much more of the acetous fermentation, and be by so much more likely to derange the stomach, and to be with difficulty assimilated; while it will have had so much more of its alimentary particles converted into the products of fermentation, which are either altogether lost, and driven off by the heat of the oven, or, if retained, render the bread in the same degree less digestible.

The bread hitherto spoken of is that made of the flour of the finest wheat, without other addition than the leaven and salt. The viscidity of the dough is necessarily much diminished, if any of the covering of the grain is left mixed with the flour; and the lightness or porosity of the bread made from it is lessened in the same degree; and, owing to this, the products of the fermentation, &c., do not so completely escape during the baking. In some people, its tendency to disagree with the stomach is, in this way, very materially increased. Yet in a large number of people, whose stomachs seldom complain unless they are dreadfully overworked, and with whom the chief grievance is a confined state of the bowels, this kind of bread is for the most part found to agree much better than that, into the composition

of which the flour enters exclusively. The coarser particles of the husks mechanically irritate the stomach and bowels, and promote the propulsion of the ingesta through them. To such people, this kind of bread may be judiciously recommended; or, at all events, it may be had occasional recourse to by them, with probable advantage. The continued use of any mechanical irritant to the bowels, is, however, a very questionable matter, by which some risk is incurred. In this case, for instance, the bran is often found to be eventually left, forming lodgments in the bowels, and risking some serious and severe derangement of the economy. In most of the cases in which bread mixed with bran is made use of, it is found to be advisable to administer, occasionally, some such aperient medicine as will greatly lessen, or wholly remove, all risk from such lodgment of foreign matter in the intestines.

In truth, one of the most important considerations for the calm judgment and opinion of the medical man, in the application of dietetics to individual cases, is to preserve a just balance, as far as attention to diet can do so, between giving the stomach more to do than its powers are capable of performing without inconvenience or irritation, and confining the individual to such a needlessly strict and very easily digested diet, as deprives the intestines of such assistance to their mechanical duty of propelling their ingesta onwards, as somewhat cruder or less perfectly digested food unquestionably affords to them. The more feeble or irritable the stomach,—

the greater the derangement of the hepatic functions,—the less well the duodenal digestion is performed,—the more important and the more strict must be the attention to diet, the more easily assimilated must be the kind of food, the less likely must it be to task unduly the digestive powers, the more likely to be quickly and fully digested, and the less likely to leave a crude and, under such circumstances, a deranging and irritating remainder, by which the existing derangement of the economy would be kept up or increased. And yet, however needful the dietetic regulation and restriction may be, the condition is almost necessarily involved, that, in direct proportion as the points aimed at are secured, in direct proportion as the food is more quickly and completely assimilated, does the action of the bowels become more sluggish, and does the artificial assistance of medicinal or other means become more needful, and must it be more frequently had recourse to. It may be often reasonably and justly objected to dietetic restrictions—"Let me return to my new bread and small beer, as articles of food, and I shall want no more pills;"—or, "My stomach feels more comfortable, my digestion certainly gives me less trouble, I have lost the acidity, the flatulence, the spasmodic pain, since I have had my diet restricted, but the increased and increasing costiveness of my habit is becoming almost as great an evil as the indigestion itself." This important circumstance, which obtains so very generally, makes it a matter of moment that restrictions in diet should

not be carried to an unnecessary extent: butter, fat, sugar, vegetables, &c., although requiring more effort for their assimilation, and being by so much liable to be imperfectly digested, and apt to occasion dyspeptic symptoms, and irritate and derange the economy, have a marked tendency to keep the bowels in a state of solvency, and by so much minister to the continued healthiness of the economy. It need not be added, that this caution, respecting the degree to which dietetic regulation should be carried, in no degree militates against the importance of such restrictions, when not pushed too far; but, on the contrary, indicates, how great may be the influence of attention to diet, on all the processes and conditions of the system.*

However well fermented bread may be baked,—

* The advantage of using more or less of the coverings of the grain, in the preparation of bread, has often been urged, on economical principles. There can be no doubt, that a very large proportion of nutritive matter is contained in the bran and the pollard; and these are estimated to constitute about one-fifth part of the entire weight of the wheat-grain. It is, unquestionably, so far wasteful to remove these altogether from the flour; and in the case of the majority of people this waste may be unnecessary, even on the score of digestibility. It has been frequently suggested, that, in cases where the introduction of any portion of the pollard and bran might be objectionable, from the risk of their proving mechanical irritants to the bowels, or from the chance of their disturbing the first or the second stage of the digestive processes, the more soluble matters might be extracted from them by means of hot water, and this water used instead of common water in making the dough. It is said, that the quantity of bread obtainable from a given weight of flour may, by this simple means, be very greatly increased, and the proportion of aliment increased in at least as large a proportion: the coverings of the grain appearing to containing a very large proportion of albuminous matter.

however thoroughly the products of fermentation may be expelled by the baking, and by letting the bread be a day or two old before it is eaten,—there are some people with whom it seldom agrees, and some states of system in which it is anything but easily digested. Of these, the most important are infants and very young children; and these furnish few exceptions to the remark. At the period of weaning, and the whole time before that period, and some little time after it, fermented bread is almost always a direct cause of stomach disturbance. But there are others with whom fermented bread disagrees. In cases of severe dyspepsia, with acrid gastric secretions, or much irritability and morbid sensitiveness of stomach, fermented bread can seldom be eaten without producing derangement. In such cases, bread that is unfermented is much more likely to agree, if it is thoroughly baked. Biscuit is the only form of unfermented bread that can be baked thoroughly,—restricting the word bread, to a mixture of flour, water, and salt, without addition. The addition of any material to these, as a substitute for the fermentation, to render the bread porous, and enable it to free itself from the aqueous and other matters, and to be sufficiently altered by the exposure to heat, in the condition of the starch in particular, for easy solution and assimilation by the digestive secretions, properly speaking brings the mixed article of food within the denomination of pastry or cake. There is an exception to this, in the case of the bread which is rendered porous, by mixing such materials

with the flour, before it is made into dough, and exposed to heat, as, united, cause carbonic acid to be disengaged,—the resulting saline addition being either common salt, or some harmless and tasteless compound. I believe that bread made in this way, if the relative qualities and proportions of acid and alkali could be duly and uniformly secured, would prove to be as easily digested, and as little likely to inconvenience the dyspeptic stomach, as any form of farinaceous food, and much less likely to do so than fermented bread,—in addition to the proved economy of the large per centage of the elements of the flour, that are expended in the panary fermentation.

When only made of flour and water and salt, and carefully and thoroughly baked, biscuit is a very easily digested article of food. To be as wholesome as possible, biscuit should either have been recently baked, or have been carefully preserved from exposure to the air, or to damp. It is otherwise apt to become somewhat accscent, and to derange the digestive organs; and this, when the palate may have been unable to detect the fact of a chemical alteration.

Ship-biscuit, in which the mass of dough is most carefully and well kneaded; and in which, in order to the biscuit keeping during long voyages, the baking is done perfectly,—is generally the best kind for the diet of children, or for that of such valetudinarians as fermented bread does not agree with. Unleavened bread requires much more baking than leavened bread, probably on account of the chemical

changes produced in the flour by the fermentation, and perhaps partly from the porosity of the fermented dough enabling the heat to permeate the dough, and the aqueous matters to escape from it more readily. Hence, unleavened bread, if baked in thick loaf-like masses, is always difficult of digestion.

Bread forms a kind of food which seldom stimulates, even when the system is out of health; and yet it is a highly nutritive article of diet. It is of some importance, moreover, in giving bulk to the more nutritive articles of food; and its very slight degree of taste enables it to be eaten along with almost any other kind of alimentary matter. The mastication of dry bread involves, moreover, the secretion and swallowing of a large quantity of saliva, which subserves important purposes in the assimilation of the food, and especially of all the articles of food which contain starch.

Saliva, besides certain saline matters, as chloride of calcium, and lactates of potash and soda, phosphate of lime, and silica, contains a proportion of free soda, chiefly in combination with mucus. When in a morbid state, the saliva occasionally shows an acid re-action, which seems to be due to the presence of free acetic acid; but in the healthy state, saliva has decidedly an alkaline character, from the presence of uncombined or free soda. According to Mitscherlich, there is 1.64 of soda in 1000 parts of saliva; and, according to Dr. Wright, only one-third of this proportion of free alkali. It is, perhaps, enough, to be aware, that the saliva, when healthy,

possesses a decidedly alkaline re-action, and that this is due to the presence of free soda. Admitting that alimentary matters are to be generally classed as being albuminous, fatty, and saccharine; the first of these, the albuminous, made to embrace all the azotised articles of food, are assimilated (as has been said before, p. 35) only by means of the gastric juice, which, besides its acid, is believed to contain a genuine ferment (pepsin), by which the food is prepared for solution and assimilation. This ferment, or organised matter in a state of change, or of virtual decomposition, seems to be an essential means, by which the first step is taken in the assimilation of all the azotised articles of food. Probably, according to Professor Liebig, derived from the transformation of a portion of the lining membrane of the stomach itself, this ferment appears to be the primary re-organising element, by which the atoms of the ingesta are once again vitalised, and brought within the influence of the organic laws. This ferment may itself prove to be a newly vitalised product of the existing disorganisation, and be identical with the various ways in which fermentation occurs out of the body, involving new organised existences, which in their turn rapidly increase, and influence the decomposing atoms in their vicinity. This ferment has been happily and well compared by Professor Liebig, to that, by which, in the germination of seeds, the atoms are made to assume such extraordinary and decisive new arrangements. The most familiar instance of this may be the sprouting of

barley; and the conversion of starch into sugar, its very striking effect.* Supposing this to be the true theory of the primary assimilation of the albuminous or azotised alimentary articles,—and that it is probable the conversion of the fatty articles of food is due to the action of the bile, or to its being in the first instance saponified, and thus weakened and fixed, and rendered miscible and capable of combining with water,—the way in which saccharine substances are assimilated in the first instance, remains to be accounted for; and for this we are indebted to the experiments and researches of M. Mialhe. For the primary assimilation of the saccharine aliments, the influence of free alkali appears to be a

* "Vegetable fibrin is subject to continual alteration by contact with water; and in this state it has the singular property of converting starch into dextrine (a soluble gum), and then into sugar. This remarkable power is best seen in germinating grain, as in malt, of which a small part mixed with a large quantity of starch, in a thick paste, and warmed to 150° to 160° very soon renders the whole quite fluid and dissolved, and finally converts it into grape sugar. That part of the fibrin which acts on the starch has become soluble in water. It is called *diastase.*

"*Diastase* is made by rubbing up malt with a little water, expressing the mixture, adding just enough alcohol to separate the albumen, and to allow the liquid to filter. The filtered liquid, mixed with more alcohol, deposits the diastase. It is purified by being repeatedly dissolved in water and precipitated by alcohol. It is finally dried at a temperature of 100° or 110°. Thus prepared, diastase cannot be a pure compound, but it possesses, in a high degree, the power of promoting the solution of starch, that is, its conversion into dextrine and sugar. One part of diastase can convert into dextrine, with a little sugar, no less than 2,000 parts of starch. Diastase is, evidently, fibrin altered, and still more prone to change. Its solution cannot be kept; it becomes rancid, and loses its action on starch."—*Dr. Wm. Gregory,* Op. Citat.

primary necessity; and this condition is found in the saliva. But, probably in the case of all the saccharine aliments, and unquestionably so in that of the purely amylaceous substances, a further means of reduction, and conversion into organised matter, is necessary; and for this, the constitution of the saliva likewise furnishes the necessary condition. As in the case of the gastric secretion, so in that of the saliva, the animal fluid contains a substance in a state of change, like the diastase or ferment in the sprouted barley; and to this diastase, called, by M. Mialhe, *animal diastase*, is the assimilation of all the starch aliments to be ascribed. By the action of this animal diastase, the particles of starch are more or less quickly, and so entirely changed, that the distinctive effect of iodine upon starch no longer obtains; and, incapable of combining and forming an iodide of starch any longer, the addition of iodine to starch, thus modified, no longer produces a blue colour; and, on the other hand, whereas, when caustic potash is added to unmodified starch, it produces no change of colour, the addition of potash to the starch, now converted, produces a deep brown colour. The rapidity with which amylaceous articles are thus modified by this animal diastase, is much influenced by the mechanical condition of the particles of starch submitted to its action. If the particles are disintegrated, or broken up, by having been boiled in water, or exposed to a highly elevated temperature, as in baking,—or partially broken up, as in the fermentation of bread,—or ground and

crushed and broken, as in mastication,—to the same extent are they more readily and completely acted upon by the salivary ferment. Hence some of the importance and usefulness of the processes of cookery, so long known to be especially important in the case of the vegetable articles of food; and hence the beautiful and remarkable provision, that the graminivorous and herbivorous animals have complicated means of mastication, and not merely incisor and canine, but grinding teeth, while their salivary glands are so much larger than are those of the carnivorous animals. Perhaps it remains to be shown and explained, how the amylaceous articles of food, that are swallowed without salivary admixture, come to be assimilated. This may, however, be explained, by the fact of saliva being subsequently swallowed for their conversion and solution; or it may not improbably lead to the finding, at length, an important use for the pancreas, which unquestionably secretes a fluid very similar in appearance, and, as it seems from the analyses, very similar in chemical character, to that of the salivary glands.

It is in some degree confirmatory of this suggestion, that, in birds, M. Magendie should have found the pancreatic fluid so largely albuminous, as to coagulate on the application of heat, and therefore so capable of acting as a ferment,—that in the experimental researches of MM. Tiedemann and Gmelin, 1000 parts of the pancreatic fluid of a dog left 87 parts of solid residue, of alkaline character, the fluid itself having been so decidedly of albuminous

character as to have been drawn out like threads, exactly as in the case with the albumen of the egg, containing moreover what they call a modified casein,—that in the experiments of the same distinguished *savans,* the pancreatic fluid of the sheep was likewise found to be alkaline and albuminous, and more decidedly so after a meal than before,—and that in the experiments of MM. Leuret and Lassaigne, although believed by M. Simon to have been less carefully performed, the pancreatic juice of the horse was found to be almost identical in its composition with that of human saliva. It remains to be determined, however, by further and more carefully conducted experiments, whether the pancreatic fluid of man and other animals, besides general similarity in appearance, in physical character, and in chemical composition, to the salivary secretion, contains a real analogue to the animal diastase discovered by M. Mialhe in the saliva, having the same physical and chemical characters.*

Fermented dough is sometimes boiled instead of

* The animal diastase obtained by M. Mialhe from the saliva is stated to be "solid, white or greyish white, amorphous, insoluble in alcohol, but soluble in water and spirit. The directions for obtaining it are the following:—Filter saliva, and treat it with five or six times its weight of absolute alcohol, adding it as long as any precipitate occurs. This animal diastase is insoluble, and falls into white flocks, which must be collected on a filter and dried. It forms about $2\frac{2}{0}$ of the whole saliva."—Animal Chemistry, with Reference to the Physiology and Pathology of Man. By Dr. J. Franz Simon, Fellow of the Society for the Advancement of Physiological Chemistry at Berlin, &c., &c. Translated and Edited by George E. Day, M.A. and L M., Cantab., &c.—Sydenham Society's Edition, vol. ii. p. 9.

being baked, forming what is called yeast or barm dumpling. This is, however, far from being as easily digested as bread. These dumplings have all the unwholesome qualities of new bread; and, furthermore, it is probable, that the gluten and the starch are not so much altered as when subjected to the higher degree of heat of the oven; the products of the fermentation being, besides, in all likelihood, not so completely expelled. These dumplings do, however, form a very nutritious kind of food, which is well adapted to men who require a large amount of support, and whose stomachs are not impaired in their functions, by sedentary habits, or repletion, or intemperance. It may be even matter of surprise, that they are not more made use of than they are, by those of the working classes, whose employment is such as to cause a large expenditure of nutriment, without disturbing the assimilating functions. But with those whose digestive powers are disordered, no matter from what cause, yeast dumplings will almost always disagree.

Vermicelli and maccaroni are modified forms, strictly speaking, of unleavened wheaten bread. They are made from the flour of the *grano duro:* a variety of wheat, the grains of which are small and hard, and which is grown chiefly on the borders of the Black Sea, and in Apulia. It is said, that the quality of maccaroni depends on its being made exclusively of the *grano duro,* or on this being mixed, and so far adulterated, with the flour of soft wheat.

The flour is somewhat coarsely ground, is made into paste by the addition of water only, which is kneaded for a long time by means of a block of wood, worked by a very simple contrivance. When sufficiently kneaded, the paste is forced by common pressure through a number of circular holes: in the case of the substance to be called vermicelli, the holes being of course much smaller than in that of maccaroni. Maccaroni is, moreover, hollow throughout, to facilitate its being thoroughly dried, which its larger diameter would otherwise render difficult or uncertain. Over each of the larger holes, intended for the maccaroni, there is a small copper bridge, raised sufficiently above the hole to enable the paste to pass under it into the hole; and from this bridge depends a copper wire, long enough to pass through the hole, and thus the paste which passes through is left hollow. The strings, whether larger or smaller, hollow or otherwise, owing to the long kneading, and especially owing to the fibrinous and glutinous quality of the grain used in the manufacture, are remarkably tenacious, and in any required length, are twisted into certain shapes, and hung conveniently to dry.

Maccaroni and vermicelli are, then, unleavened dough, not baked, but simply hardened by being dried in the air; made of the *grano duro*, probably the very best and most nourishing variety of wheat-grain, which is grown only in certain parts of Southern Europe, which appear to be peculiarly congenial to the wheat-plant. These are easily

digested forms of food; and they are at least proportionably nutritious. Stewed, and eaten with salt, perhaps flavoured with pepper, with the addition of simple beef gravy, they form a kind of food which is by no means unpalatable, and that is sufficiently easy of digestion even for most dyspeptics. Eaten along with meat, as a substitute for potatoes, or other vegetables, stewed maccaroni likewise forms a grateful article of food, and one that is useful for its digestibility. As more commonly eaten,—mixed with cheese, and baked,—maccaroni, of course, loses its good character in regard to digestibility, and can only derange the weak, or add to the labours of the overloaded stomach; unless, perhaps, by serving to stimulate it, the cheese may assist it to accomplish its difficult and enervating labours. The sensualist must pay the penalty of the expenditure, derivation, and probable exhaustion, of the nervous power, to effect the digestion of the multiplied mass, which he thinks fit to swallow; and by so much is the nervous power diverted from its higher uses, and by so much is the individual sunk from his elevated position as a thinking being.

By the art of cookery, wheaten flour is made to assume many and various other forms; some of which are in the majority of cases wholesome and advisable articles of food; whilst others must be regarded as being often of very doubtful value, if not positively injurious. Much depends upon the mode of cooking, on the nature of the matters added to the flour, and on the time at which they are eaten.

Puddings, or boiled paste, are generally more easily digested than pies, or baked pastry; but to this there are many exceptions. Butter, or lard, or suet, and sugar, or treacle, are to be looked upon as the great causes of objection to the different kinds of pastry; and milk and eggs, as the additions which are least likely to be injurious. The old-fashioned hasty-pudding, made with egg, milk, and flour, is perhaps the most digestible form of pudding. The common batter-pudding, made with the same ingredients, somewhat differently proportioned, and boiled, may probably be placed second on the list of relative digestibility. If this same pudding, without addition, is baked, it may be somewhat less easily digested, but not so much so as to be usually any ground of objection to it. If made to receive all the fat that may fall from meat while it is roasting,—constituting the Yorkshire pudding of high and old renown,—the pudding must take a low position as to digestibility, however great its claims and merits on other accounts. The pancake,—equally venerable as to fame and antiquity,—made of batter, fried in butter or fat, must be at least equally objectionable on the score of digestibility. In general, if butter or suet is added to the paste, it is more easily digested if boiled, than if baked, for the obvious reason, that the fat is less apt to be much affected in the cooking, from being subjected in boiling to a less elevated temperature. Pastry, to be as easily digested as possible, should be light, but not rich; and it should be thoroughly cooked. If it be an

object to obtain a paste, that will be the most easily digested, it should be as little rich, that is greasy, as is consistent with its being moderately light. A heavy or sad paste is an abomination to any stomach, the energies of which are in any degree impaired. The relative digestibility and wholesomeness of the different kinds of fruits, whether used in these or other ways, will have to be noticed afterwards. A paste made of flour and water, without addition, and boiled,—the hard dumpling of by-gone days,—is generally of difficult digestion.

In the question of diet, puddings and pies are of much importance; and, I think, their use may be often very unwisely prohibited. Inasmuch as they are, unless made most needlessly rich and greasy, much less nourishing than animal food,—and as they must be eaten, more or less, as a substitute for it,—they may subserve an important purpose, in lessening the risk of repletion and plethora. There is, however, the unquestionable risk, that, by variety, and the consequent gourmandise, the appetite may be stimulated to take too much food. Puddings and pies are, however, particularly important articles of diet in the case of children; serving, in some degree, as a substitute for an amount of animal food, that is apt to disagree with, and overload them. The diet of most children should be in a large degree farinaceous. It is seldom the case, that the health of children continues to be long unimpaired, into whose diet animal fibre or oleaginous matters enter largely.

Bread and milk,—or milk boiled, and thickened with flour, oatmeal, rice, or arrow-root,—or oatmeal porridge, eaten with milk,—constitute usually the very best breakfast for children; and the greater proportion of their dinner should generally consist of some plain light pudding or pie. As their age advances, it will be generally necessary to modify this plan of diet a good deal; increasing the proportion of animal food, and diminishing that of the farinaceous aliments.

Meat puddings and meat pies,—that is, meat surrounded or covered with a crust of pastry,—may, most justifiably, be placed the lowest in the scale of digestibility, in this class of dietetic articles, more especially if the crust is eaten; and these should be strictly forbidden to the invalid.

The oat is the grain of second importance as an article of diet. Little used, comparatively speaking, in the southern parts of this island, it is an important article of food in the northern counties of England, and still more so in Scotland. Oatmeal is said to be more nutritious than wheaten flour. It is reported to contain as much as one third more of albuminous matter than wheaten flour. This, however, probably gives an exaggerated notion of its nutritive properties. It is certainly less easily digested, and perhaps even less entirely digestible, than the flour of wheat.

Even if it should be eventually proved, that the experimental results of modern chemists, as to the relative amount of azotised matter contained in the flour of the different kinds of grain, is free from any

degree of error, it must be borne in mind, in practically considering the question of diet, that this becomes a consideration of mechanical condition and of chemical character, so far as these may facilitate or otherwise the process of assimilation, at least as much as it is a question of the amount of azotised, and, if duly digested, of nutritive matter. In this point of view, as regards the chemical part of the question, the practical points of the inquiry are not confined to that of what proportion of azotised matter there may be in the flour of any of the grains that are used as food, but must include that of the state in which the azotised alimentary matter is presented, whether as vegetable fibrin, albumen, or casein. There can be little doubt, that, in general, vegetable fibrin is more easily digested, and is therefore more likely to be fully and duly assimilated, than vegetable albumen; and there is, if possible, less doubt, that either of these forms of azotised vegetable food is more easily digested, and therefore more certain to be fully assimilated, than vegetable casein. It is not enough, then, to prepare us to estimate the question of the comparative nutritiveness of the different grains, to ascertain the amount of azotised matter contained in a given weight of the flour obtained from them respectively; and we can by no means infer from any such experimental results, that bean-flour is more than twice as nutritive as the flour of wheat, or linseed-meal little less nutritive than bean-meal, or oat-meal much more nutritive than wheaten flour. In the case of bean-meal, although

the absolute amount of azotised matter contained in a given weight may be so much greater than that contained in wheaten flour, the amount of vegetable fibrin is probably very considerably less,—the difference and excess of azotised matter being made up in a great degree by vegetable casein; and in the case of linseed-meal and oat-meal, the amount of vegetable fibrin is probably likewise much less than is contained in wheaten flour,—the difference and excess being made up by vegetable albumen. Without reference to this consideration, and the probable consequent degree of digestibility, and the likelihood of the more or less perfect assimilation of the whole amount of azotised matter contained in them severally, it would be as little justifiable to say that one grain is therefore more nutritive than another, as it would be to say that the flesh of the different animals that are used as food, is nutritious in proportion to the amount of nitrogen contained in it,—or that the degree of nutritiveness of the different parts of those animals could be thus determined,—which is, beyond all doubt, by no means the case.

The mechanical condition, moreover, in which the flour of the different grains is necessarily presented to the action of the assimilating organs, must have much to do with the facility, and the probable degree, of their assimilation. In the case of oatmeal, this may be reasonably inferred to offer some degree of greater mechanical hindrance to the action of the digestive organs, and to justify corresponding deductions from the inferences as to the relative amount of nutri-

tive quality in oatmeal, when used as the food of man.

Although, then, the proportion of vegetable fibrin contained in any grain, is not a fair criterion of its nutritive quality, as was at one time believed; because the amount of azotised matter contained in it in other forms, must likewise form part of the estimate;—the proportion of gluten contained in such flour is not without some degree of practical interest, even with reference to the question of nutrition.

According to the analysis of Sir Humphrey Davy, oatmeal does not contain more than a third of the proportion of gluten, that is contained in wheaten flour; and it is at least proportionally less viscid or tenacious.

The oat will grow and thrive in much colder situations, than any other of the grain-bearing plants; indeed, even many parts of the south of England are said to be too warm for it; and the grain produced in those districts is reported to be less farinaceous, and less nutritious, and probably less wholesome as food, than that produced in the more northern and colder counties of England, and in Scotland. Much of this may be accounted for by the structure of the plant, and the disposition of its seeds. Each grain in the ear—or rather, in this case, the panicle—is separated from the others, and mounted on its peculiar stalk; and from the weight of the grain, when advancing to ripeness, the seeds are bent downwards, which protects them effectually from the immediate

contact of moisture; while the separation of the seeds from one another, prevents the oat from being liable to many diseases, to which the seeds of most other grain-bearing plants are subject. But, it will be observed, that this arrangement of the seeds exposes them individually much more to the direct influence of the sun, and enables evaporation to take place much more quickly from their surfaces, than is the case with wheat, or barley, or rye; and thus the oat requires moisture more essentially than they do, —at the same time bearing much heat worse, and requiring it less. It is probably on these accounts, that the oat seldom thrives in the warmer districts, and is almost always of better quality when grown in colder situations; and, perhaps, this may be one reason, if not the principal reason, why this grain is so much more used by the inhabitants of the northern parts of this island, as a staple article of food, than it is by those of the southern districts.

Oatmeal is a very substantial article of food. No one could look upon the Scottish peasantry, with whom it is the chief article of subsistence, without becoming convinced that this grain is largely nutritious. Living upon little else than oatmeal bread and oatmeal porridge, and butter-milk, with a broth almost wholly vegetable, these men are proverbially hardy and strong, subject to few ailments, living to a fully average age, and capable of enduring a great deal of fatigue, and that for considerable periods at a time.

Oats passed through a mill, by which they are

freed from their husks, constitute the *groats*, so much used in making gruel. Gruel, whether it be made from groats, or from oatmeal, is a most valuable article of invalid diet. It is in general very easily digested, seldom giving even a much disordered stomach any inconvenience; while it is much more nutritious than is commonly believed. A bland demulcent, it soothes the stomach when its secretions are acrid or disordered; and from having some small degree of consistence, it often sits easily on the stomach, when a more liquid beverage would be rejected, or occasion pain or inconvenience. Varied as to its degree of consistence, and given in the quantity, and at the intervals of time, which may be most desirable, it furnishes a most valuable palliative in many cases of illness, and a most excellent remedy —for in that light may it be fairly regarded—in many cases of dyspepsia. Being at once moderately nutritious, and in most instances very easily digested, its value in cases of protracted indisposition can hardly be estimated. It is valuable as a diet-drink,—as a means of protecting the stomach from acrimonious and irritating secretions,—and as a supper for those invalids, who cannot go to bed supperless without pain and sleeplessness, and yet with whose stomachs most kinds of food disagree, the disturbance occasioned by the indigestion almost banishing sleep. It is sometimes urged against the use of gruel, that its fluidity interferes with its being easily digested, and that its bulk often renders it irritating to the disordered stomach. If the

quantity taken at a time is regulated carefully, these objections to the use of gruel will be of rare occurrence. Half a tea-cupful of gruel, or even less, every two or three hours, has been found to answer every purpose in the majority of cases, when such rigid abstemiousness, and such a rigorous simplicity of diet, have been necessary, or when almost any other kind of food has been productive of stomach-disturbance. In inflammatory affections, thin oat-meal or groat gruel, with no other addition than a small quantity of salt, is probably the kind of food that is least likely to occasion disturbance; when, indeed, it does not appear to be necessary to confine the patient to water, or toast and water, exclusively. In severe cases of indigestion, characterised by a highly acrimonious state of the gastric secretions, and an irritable or inflammatory condition of the stomach, there is no plan of diet that is so generally successful, as a rigid restriction to gruel, with or without the addition of bread or of biscuit. It is often an important, if not the primary, part of the treatment of such cases. There are, of course, exceptions to the advisability of a gruel diet, even under such circumstances as these; but such cases are comparatively rare. There are individuals, with whose stomachs, oats, in any shape or form, will never agree; and there are cases even of severe dyspepsia, in which a system of dry-dieting—living upon solid food, and drinking only between the meals—is the only effectual way of combating the disease; but these form few and rarely-occurring exceptions to the greater number of dys-

peptic cases. When gruel is found to agree at the first, and for some little time, it sometimes ceases to do so, and comes to occasion dyspeptic symptoms. It is usually sufficient to intermit its use for a short time, in such cases as these; resuming it after a time, if it should seem to be still indicated. With these observations, should be connected the importance of ascertaining that gruel is well and thoroughly cooked. Gruel, to be fitted for the use of invalids, should be boiled for at least an hour. In many cases, where it is thought to disagree, this will be found to be owing to its having been imperfectly cooked.

Oatmeal is likewise used, and deserves to be much more used than it is, in the form of what is called stirabout or porridge. This is made, by gradually stirring oatmeal into boiling water, until enough has been added to give the required degree of consistence,—continuing the boiling until the meal is sufficiently cooked. It is commonly eaten, either with milk, or with butter-milk. This is usually a very unirritating kind of food—an article of diet which is well adapted to the case of children, and little less so to that of dyspeptics; and for the labouring population, it forms a breakfast that is much more nourishing and wholesome, than the tea, and the bread and butter, or bread and dripping, which are in England so much more generally made use of. Bread and milk, although certainly well suited to the stomachs of most children, is nevertheless found to disagree with some; and as a general breakfast for

children, I think, that oatmeal porridge and milk deserves to be preferred. It is an unstimulating diet; it is very easily digested; it contains a very considerable proportion of nutriment; and it seems usually to act slightly on the alvine excretions,—while, in many cases, a continued use of milk renders it necessary to take an occasional dose of aperient medicine.

Brose is another article of diet which is made from oatmeal. The process consists simply in pouring boiling water upon oatmeal, and stirring them together. The meal is consequently very imperfectly cooked; and however well it may agree with the stomach of a hardy North-country man, it would seldom be equally suitable to those of more civilised, and consequently more delicate people. If, instead of boiling water, the fat skimmings of soup be poured upon the oatmeal, that vaunted Scotch dish, *fat brose*, is the rich and indigestible result. It must require extraordinary powers of digestion, to be able to assimilate this without inconvenience.

Oat-cake, made by baking a paste of oatmeal and water, rolled out thin, on a girdle, or slab, of iron or stone, placed over the fire, is another way in which oatmeal is made use of as food. There are two kinds of oat-cake; the one of which is more commonly made use of in Scotland, the other being more used in Derbyshire, Yorkshire, and the adjacent counties. The first of these kinds is made by simply working up meal and water into a paste, rolling it out to a sufficient degree of thinness, and baking it forthwith.

In the second kind, advantage is taken of the great tendency of oatmeal to undergo the acetous fermentation. A little of the stale dough, already in a fermented state, is commonly added to the paste, and in a short time the whole is sufficiently leavened. The first kind is very short and dry; the second kind is much tougher and moister. The latter varies a good deal in different districts, according to the degree of fermentation the meal has been made to undergo before the baking. The preference given to either the unleavened or the leavened kind depends, of course, chiefly on habit; of the two, it is probable that the unleavened variety is the more easily digested. The remarks on the digestibility of oatmeal, when in the form of gruel or porridge, are not applicable to oaten bread. It is apt to disorder a weak or irritable stomach.

Barley is now little used as an article of food; although scones, or thin cakes, of barley-meal, have still a place in the farm-houses of the north. But, much as the consumption of barley, as a direct article of food, has decreased, it is more and more in demand for the production of beer and spirits; and the demand for barley is probably little less great, than when a large proportion of the bread used in this country was made of it.

Barley possesses some advantages over most of the other grain-plants, which, under certain circumstances, must be of considerable importance. It bears heat and drought better than they do; it will grow on lighter soils; and it arrives more quickly at

maturity; so that, in many barren situations, in which the summer is too short to admit of the ripening of wheat, barley becomes the staple article of food. So rapid is its growth, that, it is said, the farmers in Spain, and in other countries having a similarly high temperature, can grow two crops in the year. The chief peculiarity, however, in the growth of barley, is the injury it receives from excessive moisture. Owing to the chemical constitution of the grain, barley is exceedingly apt to sprout in the ear; and a degree of moisture, which might probably be no more than the other grain-plants would bear well, and thrive with, would produce in barley this result. It is owing to the facility with which it germinates, that this grain is so suited to the purposes of malting.

According to the analysis of Dr. Prout, barley contains only 3 per cent. of gluten; which is only one-half the proportion contained in oats; and not more than a sixth to an eighth of that contained in wheat. But, from the more recent analysis, it would appear to contain more than $11\frac{1}{2}$ per cent. of albuminous matter, in some form or other. Barley contains about 5 per cent. of sugar. The process of malting consists in making barley undergo the first stages of germination, by steeping it in water, and then placing it in a heap,—when its temperature increases,—it absorbs oxygen and evolves carbonic acid,—the seeds swell,—the radicle and plume elongate,—and, when the germination has been carried far enough, to produce the largest conversion

of the hordein and the starch into saccharine matter, the further change is arrested by drying the grain at a somewhat elevated temperature. Dr. Prout's analysis of the changes in the composition of the barley when converted into malt, gave the following results :—

	In 100 of Barley.	In 100 of Malt.
Resin	1	1
Gum	4	15
Sugar	5	15
Gluten	3	1
Starch	32	56
Hordein	55	12

The hordein, mistaken for starch by the previous experimenters, is said to differ from it in being insoluble in hot water. It is the hordein which is converted into saccharine matter in the process of malting. But the starch is a good deal altered in its character during the changes produced in the malting of barley, although increased rather than diminished in its relative quantity; and starch is proved to be convertible into sugar,—by boiling it with diluted sulphuric acid for a long time, and then saturating the acid with chalk, filtering the soluble matter from the sulphate of lime, and evaporating, purifying, and crystallising, in the usual way. It is quoted from Nicholson's Journal, in Professor Brande's Manual of Chemistry, that "Dr. Tuthill digested a pound and a half of potato starch (obtained from about nine pounds of potatoes) in a mixture of six pints of distilled water, and a quarter of an ounce (by weight) of sulphuric acid

at a boiling heat; the mixture was afterwards stirred, and fresh water occasionally added to supply loss by evaporation. After thirty-four hours, an ounce of powdered charcoal was added, and the boiling resumed for two hours. The acid was then carefully saturated by lime, and the boiling continued for half an hour, when the liquor was strained through calico. The insoluble residue, after having been washed and dried, consisted of charcoal and sulphate of lime. The filtered liquor was evaporated to the thickness of syrup; and being set aside, became, in eight days, a crystallized mass, resembling brown sugar and treacle. The sugar weighed one pound and a quarter. One pound of it, fermented in the usual way, afforded, on distillation, fourteen drachms of proof spirit. MM. de la Rive and Saussure have shown that the contact of air is unnecessary in the above process; that no part of the acid is decomposed, no gas evolved, and that the actual sugar obtained exceeds, by about one-tenth, the original weight of the starch." The solution of the starch, and its conversion into sugar, is owing, as has been said some few pages back, to the presence of a substance in a state of decomposition (diastase), which acts as a ferment, and throws the molecular atoms into new movements and combinations. One part of this diastase, which modern chemistry has shown to be separable and independent, is capable of producing this great change in two thousand parts of starch: a change, the degree of which is more readily estimated, by

looking at the figures taken from Professor Liebig's work on Animal Chemistry.

	Starch Calculated, C 12, H 10, O 10.	Sugar (Grape or Starch Sugar) Calculated, C 12, H 14, O 14.
Carbon	44·91	36·80
Hydrogen	6·11	7·01
Oxygen	48·98	56·19

The principal use now made of barley, used as such for food, is in the form of the decorticated grain,—constituting what is called pearl-barley. Bread made of barley-meal, although palatable to most people, is usually digested with some little difficulty,—owing, perhaps, in part, to the bread being necessarily heavy, from the extremely small proportion of gluten which it contains. Pearl-barley is a valuable addition to broth, serving to increase its consistence, and forming a kind of semi-farinaceous food that is in general more easily digested; and pearl-barley is further valuable, on account of the valuable diet-drink that is made from it. Barley water, or barley gruel, from the larger proportion of gum that it contains, is more suitable than oatmeal gruel to some people. One inconvenience is the long time required for its preparation,—two or three hours not being too long a time for its concoction. Equal parts of skimmed milk and barley water, often afford a useful and simple form of diet for the invalided, which is at once easily digested and moderately nutritious. The importance of frequent and recent preparation is to be kept in mind, in the case of barley water, as it very soon becomes acescent.

Rye, which was, in olden times, one of the most extensively used of the grain-plants, in the food of man, has, by degrees, become less and less used; until the plant has almost ceased to be cultivated in this country, on account of its usefulness in this way,—being grown principally for the sake of its straw, or on account of the uses of the grain in certain manufactures. Rye contains, however, according to Sir Humphrey Davy's analysis, more than 10 per cent. of gluten; and it contains, moreover, a considerable proportion of saccharine matter. It is readily convertible into malt; but this appears to be by no means of so productive a quality as that obtained from barley,—yielding comparatively little alcohol on fermentation, and being, besides, exceedingly apt to pass from the vinous to the acetous fermentation.

This grain is said to thrive on a much more sandy soil than any other of the cerealia, and hence to be of much importance in the extensive sandy districts of Sweden and some parts of Russia. It seems to be the chief article of food in those countries. Where it does not derange the system, by producing much acidity during its digestion, rye-bread may prove useful, by exerting some degree of laxative effect. The peculiar disease to which this grain is subject during its growth — the ergot — may be mentioned, inasmuch as, when so diseased, it exerts such a powerful influence if taken into the human system, — becoming valuable, under some circumstances, in a medicinal point of view,—but having,

at different times, in the countries where it was used as the staple food, given rise to most extensive disease of very awful character; marked by gangrene of the extremities, and impaired nervous power,—affecting, moreover, the sensorium, and often ending in death. It is said, that, happily! bread made of diseased rye has a characteristically acrid and nauseous taste. Rye-flour is sometimes mixed with wheaten flour, in this country, to make a brown bread, that often agrees with the stomach sufficiently well; while it tends to keep the bowels in a solvent state.

Rice is a grain of extensive importance, throughout the vast continent of India, and the great Chinese Empire. Its introduction into America seems to be of comparatively modern date; and rice is said to be much less used as an article of food in America than maize and wheaten flour. Rice requires for its growth a very large amount of moisture, as well as a temperature of considerable elevation. For the germination of the grain and the growth of the plant, the soil must be, either naturally or artificially, for the most part covered with water. It has been acutely advanced, that this circumstance makes rice of less real value as a staple food for man, on account of the uncertainty of the crop; and indeed the entire loss of the crop might be consequent upon a season of even moderate drought.

Rice contains,—according to Prout's analysis, as given by Raspail,—from 3 to 4 per cent. of gluten, 85 per cent. of starch in a state of considerable purity, and nearly 5 per cent. of hordein. The proportion

of albuminous matter of any kind contained in it, appears, however, to be about 8 per cent. But as far as dietetics are concerned, it may be considered as being virtually and essentially a modification of starch; and it is a most valuable and important article of invalid diet. Having little flavour, it may be mixed and eaten along with almost any other kind of food. Simply boiled, it forms a grateful and useful addition to the meat, in cases where potatoes, and vegetables generally, are found to disagree with the stomach; and when mixed with milk, or fruit, or soup, and thoroughly cooked, it has become more and more used and valued by dyspeptics. The importance of letting the grains be thoroughly swelled, completely cooked, and yet left unbroken, seems to be even now insufficiently appreciated.

Maize is a grain of extensive and probably increasing value in the food of man. It contains little gluten,—using this word to signify the albuminous principle in combination with the peculiar binding material, that is so largely present in wheaten flour. Of albuminous matter in other forms, it is said to contain nearly 11 per cent. Throughout the American continent, it is a staple article of food; and its large capabilities of serving as nutriment for men and cattle, are beyond doubt. From the deficiency of gluten, the bread made from it is dry and crumbling; and it is so different in its character from the bread made from wheaten flour, as to require the usage of years to make it generally liked as well as wheaten bread. But those who have made use of it from childhood, are

said to prefer it to any other kind of "bread-stuff." When mixed with a small proportion of wheaten flour, biscuits are made of maize-meal, which have the peculiar and by no means ungrateful flavour of the grain, and which appear to be sufficiently digestible. If mixed with a larger proportion of wheaten flour, maize-meal is made into a household-bread, of highly nutritive quality, and which seems to be digested without undue difficulty. Maize-meal is, however, much more used and valued, in different forms of pudding and porridge; and these appear to be little inferior in degree of digestibility, to the same viands made of wheaten flour.

Peas-meal is chiefly noticeable, on account of the large proportion of vegetable casein contained in it. It is, whether for this reason or not, by no means easily digested, and is almost always found to disagree with the feeble stomach. It contains a very small proportion of gluten; and the bread made from it is necessarily heavy,—even although it be baked in loaves that are by no means thick. It is seldom, however, used in the form of bread in this country, unless it may be in the north; and even there it is probably less and less made use of in this way. As might be inferred, from the casein contained in it, peas-meal proves a very nutritious article of food. It is now chiefly used to thicken and flavour soups and broths,—and is in especial requisition for these purposes on board of ships. Whether it is so much used in the diet of sailors, from being found to act in any especial degree as an anti-scorbutic,—or simply from its

proving abundantly nutritious,—or from its marked flavour, possibly covering the taste of other food, rendered somewhat rancid from long keeping,—does not appear to be ascertained.

POT-HERBS, ROOTS, &c., EATEN COOKED.

1. Asparagus—Sea-kale—Celery—Vegetable-Marrow—Artichoke.
2. Cauliflower, the heart.
3. French Bean.
4. Potato, if dry; or, as it is called, mealy.
5. Spinach.
6. Turnip.†
7. Cabbage—Greens.†
8. Carrot.††
9. Parsnip.††
10. Pea.††
11. Broad, or Windsor Bean.††
12. Mushroom.††

The whole of the individuals in this list, should be generally considered as being likely to disagree with the dyspeptic or the feeble stomach; and their effect during digestion should be watched with corresponding care. It is a great truth, that food should never be felt in the stomach at all; and whenever it is felt, to however small a degree, there is evidence that the functions of the stomach are deranged, and that the food has not been adapted to its powers or its condition.

Asparagus, Sea-Kale, Celery, Vegetable-Marrow, and Artichoke, placed first in the table, are comparatively seldom found to disagree. They consist essentially of mucilaginous matter,—a modification of gum, in its turn a modification of starch,—and, so far, simply non-azotised. They all contain, moreover, a peculiar vegetable principle, probably different in each, on which their taste, &c., depend. This some-

times affects their digestibility, and consequent wholesomeness. Some persons cannot eat asparagus without being deranged by it, on this account. This happens, however, in comparatively very few instances; and usually these vegetables are digestible in proportion to the absence of hard fibre,—and probably digestible in the order in which they are placed in the table. The essential principle referred to, is probably in every case in very minute proportion, and seems to be a highly azotised substance.

The heart of the cauliflower is usually digested with sufficient readiness, to make its use unobjectionable. The whole of the edible individuals of the genus Brassica,—cabbage, brocoli, greens, and cauliflower, consist chiefly of mucilage, with a rather considerable proportion of saccharine matter. Like most of the other succulent vegetable substances, they are composed of a very large proportion of water—100 parts being said to afford little more than seven parts of either mucilage, sugar, or albumen; the latter being in comparatively very small proportion. They are consequently by no means nutritious articles of food; and it should be added, that their watery constitution leads to their disagreeing in many instances. Generally speaking, the substances in the above table are found to disagree, in proportion as they contain more component water,—as they contain a larger proportion of saccharine matter,—and in proportion as they have a more fibrous character; and, on the other hand, are more easily digested, the larger the

proportion of mucilage, or starch, which they contain,—and the less of any other constituent.

French or Kidney-beans, if young, and therefore as little fibrous as may be, seldom disagree, even with the dyspeptic stomach. These too are chiefly mucilaginous; but they probably contain, even when very young,—although of course in still larger proportion when older,—a greater amount of albuminous or azotised matter than cabbage or cauliflower; and may be inferred to be correspondingly more nutritious.

The potato has come to be a very important, and probably an unduly important, article of food. Potatoes are said to contain about 25 per cent. of nutritive matter; and of this about four-fifths seem to be starch;—the remaining one-fifth, or 5 per cent. of the whole, affording between one and two parts of saccharine matter, and rather more than three parts of albumen. The potato is unquestionably a moderately nutritious article of food, but is not so much so as has been ordinarily supposed,—and probably not more than one-fourth, if so much as one-fourth, as nutritious as wheaten flour. In fact, this estimate of the nutritiousness of the potato, supposes the sample to be of first-rate quality. Containing so much less of azotised matter than is contained in wheaten flour, the potato may be considered as essentially a non-azotised aliment,—of much importance in diluting highly azotised food, and diminishing the tendency to the large class of diseases, which are either produced or aggravated by what may be called azotic plethora.

The introduction of the potato has probably had much effect, in lessening the prevalence and severity of scorbutic, calculous, and arthritic disorders.* At the same time, trusted to unduly, from the facility of growth and cultivation, and the large obtainable produce, it should be borne in mind that this vegetable may prove injurious, from containing so large a proportion of watery matter, and so small an amount of azotised aliment. The quality of the potato is likewise so important a question as regards its nutritiveness and its digestibility, and this depends so much on the healthiness of the plant, the season, soil, &c.,—for the plant, one of a poisonous class, is apt to degenerate, and is easily affected in its healthiness, and the tubers are equally apt to lose their good qualities as esculents,—that the potato should never be allowed, under any circumstances, to occupy, as the staple

* "We have before us an account-book bearing date from the middle to the latter end of the last century, and in it we find some interesting entries of the comparative prices of meat and vegetables. The prices for a long period run as follows:—'Quarter of a sheep, two shillings; peck of potatoes, sixpence.' In the same district, at present, potatoes are often only threepence a peck, whereas mutton is sixpence a pound, and sometimes more. The gentleman who gave us this account-book, and who is now more than seventy years old, informs us that when he was young, no potatoes were kept for winter use, and that the only other sort of garden-stuff used was a coarse kind of kale, the leaves of which were stripped off the stalk, and prepared for the table by plain boiling. This vegetable was tough and unpalatable; and during four or five winter months the food consisted, almost exclusively, of meat, bread, and flour puddings. The change which extensive cultivation of the potato and diffusion of gardening has wrought in the nature of the food of the population generally, is remarkably great, and well deserves the attention of physicians."—From a valuable article, in 'the Library of Medicine,' by Dr. William Budd.

aliment of any class of our population, the place of any of the grain-bearing plants.

The more mealy the potato when cooked, the more nutritive its quality, and the more easy its digestion. It is of little signification as affecting the digestibility, whether the potato be roasted or baked, or boiled,—provided the quality and the cookery be unimpeachable. They are probably more nutritive, —that is, contain more azotised matter,—if boiled with their skins on, than if peeled before boiling; but it is equally probable that they are more easily digested if peeled before they are boiled,—the part nearest to the skin, and necessarily removed in this case, being less easily digested. The new or immature potato, is much less easily digested than the fully ripened tuber, and should certainly be forbidden to the majority of dyspeptics. Early and forced potatoes must be less easily digested, than those which have been grown with the advantages of free exposure to the air and the sunshine.

Spinach is in general easily digested. The extreme tenderness of the fibres may in part serve to account for this; but it is, no doubt, mainly owing to a peculiar extractive principle, which acts as a stimulant to the stomach and bowels,—and in many people to the extent of exerting laxative properties.

Turnips contain a very small proportion of nutritive matter; probably little more than four per cent. The greater proportion of this is saccharine matter — the quantity of mucilage being very small. Turnips likewise contain an essential oil. The turnip consists

of fibres which are apt to resist the ready action of the stomach, independently of the frequent cases in which the essential oil proves irritating to the digestive organs. The younger, and therefore the less tough the fibres; and the less acrid, and therefore the less of the essential oil contained in it; the more easily is the turnip digested.

Cabbages and greens are digested with difficulty; perhaps partly because they contain so large a proportion of component water, and partly on account of the hardness of their fibres; but in some degree likewise, there is no doubt, from their tendency to undergo the acetous fermentation. They are peculiarly apt to occasion flatulence and acidity during their digestion; even when they do not otherwise derange perceptibly the digestive organs. The cabbage, or the variety in which the leaves are so close as to compress and blanch one another, is composed of smaller and less tough fibres than kale, colewort, or greens, the other important variety of the cultivated brassica,—and is by so much more easily digested.

The tendency of the cabbage to undergo fermentation, is taken advantage of in the great and favourite preparation, so much used and valued by the Germans —the celebrated Sauer Kraut. For the preparation of this, the cabbage is made to undergo fermentation under pressure, with the addition of salt, and a little olive oil. This is, no doubt, a valuable antiscorbutic; and appears to be easily digested by those accustomed to its use; and may be conceived to be a

sufficiently important addition to a diet, consisting largely of highly azotised food.

Carrots, from containing a harder fibre than turnips, and a larger proportion of saccharine matter, are proportionably more difficult of digestion. They are more nutritious than either the turnip or the cabbage,—containing nearly 10 per cent. of azotised and non-azotised matter.

The parsnip is equally saccharine, and rather more mucilaginous, than the turnip. It is now very little used in this country. It is by no means easily digested; and perhaps even less so than the carrot, although its fibres appear to be more tender.

Green peas are usually digested with difficulty. This, however, much depends on their age and character. When young, and of good quality, they are much more readily digested than when older and harder. Although by no means so nutritious as when matured, green peas contain a large proportion of nutrimentary matter, and prove to be a valuable article of food. They can, however, seldom be eaten by the dyspeptic, without disturbing the functions of the stomach.

Broad or Windsor beans contain much nutrimentary matter; but they are digested with difficulty,—and can only be made use of with impunity by the healthy and the strong.

The ripe and dried peas are used more or less in soups, stews, and made-dishes; and several varieties of dried beans appear to be used very extensively, particularly in Mexico, in the same way, or served

simply. There can be no doubt of the highly nutrimentary character of beans and peas, when used in any way as food,—supposing the digestive organs to be equal to the assimilation of so large a proportion of vegetable casein. Some of the kinds of bean that are thus used, are remarkably free from any marked flavour,—having much less flavour than the dried peas,—and may prove to be, in the same proportion, more easily digested.

The edible varieties of mushroom must be classed among the kinds of food, that are with difficulty digested. Apart from the difficulty of their assimilation, they are probably very nutritious articles of food. They are chiefly used in the manufacture of ketchup; and thus prepared with salt and spices, and used only in small quantities, to give their flavour to other articles of food, are seldom found to disagree. Truffles and morels, likewise, belong to the esculent fungi. They are not easily digested, if used in sufficient quantity to make their assimilation a question of any importance.

It should be appended to the remarks on the vegetables that are eaten cooked, that the season of the year, and the temperature of the weather, have much to do with the question of their wholesomeness and value as articles of diet,—and influence very greatly both the functions of the stomach, and the necessities of the system. This may be greatly owing to the amount of aqueous matter consumed and required by the system in warm weather, and which is offered to it very freely, and probably in a form that is very

readily made use of, in these articles of diet,—which are so largely composed of combined water, that some of them afford only four per cent., and, with the exception of the potato, few so much as nine per cent., of solid matter, whether soluble and nutritive or otherwise,—the large remainder being aqueous matter. Those articles of diet, on the other hand, which contain a very small proportion of component water, have, in most cases, to be reduced or diluted in their composition, by the addition of the water contained in the body itself, before they can be assimilated, and made to form part of the living organism; and by so much are they less fitted for food, when the system has more need for, and expends more largely, its watery supplies,—not only for the purpose, as is the case at all times, of dissolving saline and effete matters, that have to be eliminated, but by means of vaporisation, of lowering more or less, as may be required, the temperature of the body, and maintaining it at that same level of heat, which is found to obtain with so small an appreciable degree of difference in the human system, in all climates and seasons, and at every degree of atmospheric temperature. Independently of the large expenditure of aqueous matters, in subserving the elimination of all the other secretions and excretions of the body, a very large quantity of water is required to maintain the due proportion of vapour which is exhaled with the expired air, and which must be furnished with more or less readiness by the system, in proportion as the demand for aqueous matter for the other

proeesses of the eeonomy is less or more eonsiderable.

Independently of the great, and easily appreeiated value, of what may be ealled the weaker or more aqueous forms of vegetable food, when the system is in eireumstanees to eonsume and expend a larger proportion of watery matters, these diluted forms of food are important and valuable from their being so little nutritive in proportion to their bulk, assisting the eonsumer to adjust the amount of his food to his wants and expenditure. Man undergoes less voluntary exertion, either of mind or body, in warm elimates and seasons, than in a eolder atmosphere; and he therefore expends not only less earbon in the maintenanee of the bodily heat, but less nitrogen in the reproduetion of tissue. Henee the value of largely diluted forms of alimentary matters under these eireumstanees, and their eomparatively small neeessity in the eolder latitudes. The praetiees of different nations, in different elimates, afford striking illustrations of the importanee of these eonsiderations.

It follows, that the same objeetions whieh would apply to these vegetables as artieles of food, in the eold months of winter, would be by no means neeessarily applieable in the hot months of summer. Indeed, unless they produee deeided disturbanee during their passage through the stomaeh and bowels, a moderate proportion of fresh vegetables ought to be eaten at sueh seasons, even by the dyspeptie; and to men who are enjoying an average state of health, a

moderate daily use of fresh vegetables is almost indispensable to the security of the health.

It seems to be unquestionable, that, besides their great importance as weak and aqueous forms of aliment, containing little azote, and but a small proportion even of carbon, fresh vegetables, whether eaten cooked or otherwise, have some great influence on the chemical condition of the blood itself. In what this influence essentially consists, is doubtful; but its effect seems to be to prevent the blood corpuscles being diminished in their normal number,—and, likewise, so far to maintain the full and high organisation of the great vital fluid, as to decrease, as much as possible, the chance of a degeneration in its coagulable and other essential properties, which are important to the health and vitality of the system. The word putrescence, or putrescent tendency, if at all applicable to the blood as existing and circulating in the system, may be said to antagonise the effect of recent vegetables as articles of food; and they are considered to serve as antiseptics in the economy, and assist in keeping the blood in such a state of composition, as preserves it from the chances of such degeneration.

VEGETABLES, EATEN UNCOOKED.

1. Water-cress—Mustard—Garden-cress.
2. Lettuce.
3. Celery.
4. Radish, if the acrid rind is removed.
5. Onion—Leek—Shallot—Garlic.†
6. Cucumber.††

The water-cress (Nasturtium officinale), the com-

mon garden-mustard (the young plants of the Sinapis alba), and the common garden-cress (Lepidium sativum), are generally digested without inconvenience,—containing, moreover, each of them, a peculiar essential oil, which is palatable to most people, and affords a very grateful stimulus to the stomach and the appetite.

The lettuce is one of the most valuable of this class of vegetable substances. It is generally sufficiently digestible. It contains an important narcotic principle. Although this principle exists in no large proportion in the young vegetable,—increasing, however, rapidly as the plant becomes matured, and giving a characteristic bitterness to the taste,—the proportion of narcotic effect may be a sufficient reason for prohibiting the use of the lettuce under some circumstances. The younger, and the more quickly grown, and the less strong and tough the fibres, the more digestible is the lettuce found to be. Its digestibility may be promoted or otherwise, according to the state of the stomach, and other circumstances, by the addition of vinegar, or sugar, or oil, or cream, or any or all of them. It may be difficult, and sometimes impossible, to determine beforehand, whether such addition be advisable or not; but in the case of the dyspeptic, it may be said with sufficient confidence, that, if lettuce does not prove to be readily digested, with the single addition of a moderate quantity of common salt, it may be wisely prohibited altogether.

The foot-stalk of the leaf of celery (Apium graveolens), is the part generally used in this country; and this is usually blanched in the cultivation. If

the stalks be of carefully selected quality, and well and quickly grown, and quite young and tender, they generally agree even with the dyspeptic stomach, and are a grateful, and probably useful, addition to the unobjectionable articles of food. It is probably, however, less easily digested when eaten uncooked, than when boiled. The seeds of the plant are useful, in giving the peculiar flavour to soups, &c.

The radish is not so easily digested, as the vegetables hitherto mentioned. The more young, the less tough, and the less acrid, the more easily is it digested. Radishes should always be scraped, to free them from the acrid rind; and they should be made use of cautiously in the instance of dyspeptics.

The alliaceous plants furnish important articles of food or flavouring, to the people of most of the European countries. They are less easily digested, in proportion as they are of stronger flavour, and have more acridity. As far as the invalid and the dyspeptic are concerned, their use must, in general, be strictly forbidden; but they furnish a much-prized addition to the poor man's comfort. In different districts, whether from accidental circumstances, or the nature of the food with which they are mixed, different individuals of the class are preferred. The leek is probably the most easily digested, and the garlic the least so. The foreign onion, grown to a large size, in a congenial climate and soil, and having comparatively little acridity, is necessarily much more easily digested than the stronger varieties of onion. The odour and the taste of all these plants is pecu-

liarly offensive to some people, and apt to disagree with them in the same proportion. The onion, when eaten very young and immature, is much more easily digested than the matured bulb. The digestibility of these vegetables is probably much increased by their being cooked, and especially perhaps if boiled, as in this case some part of their acrid juice may be supposed to be removed. Their digestibility and usefulness are much depeudant on the habits, and other eircumstances of life, of the eonsumers. In the case of people who have to subsist ehiefly on the aqueous articles of food, and on a meagre diet, and especially if exposed to a damp and cold atmosphere, this class of vegetable substances is of much importance, and probably materially assists digestion, aud promotes the healthiness of the system.

The genus Cueumis, affording as the fruits of its different species,—or those of the allied genus Cucurbita,—the melon, the water-melon, the vegetable-marrow, besides the plants of which the fruits yield the valuable medicines elaterium and colocynth, likewise contains the cucumber (cucumis sativus, vel hortensis). The seeds of this plant yield an oil; and to the presence of this in the fruit, whether in the seeds or in the pulpy matter, may the difficulty with which cucumber is ordinarily digested, in all probability, be ascribed, — and not simply, or perhaps in any importaut degree, to the aqueous and cooling character of this fruit, to which its difficulty of being digested is more commonly referred. To whatever it may be owing, however,

this vegetable is very notoriously apt to derange the functions of the stomach; and it should be strictly forbidden to most dyspeptics. The addition of pepper and vinegar facilitates its digestion.

FRUITS AND SEEDS.

1. Grape.
2. Orange.
3. Strawberry.
4. Raspberry.
5. Pine-apple.
6. Currant.
7. Gooseberry.
8. Peach—Nectarine—Apricot.
9. Apple, Pear.
10. Cherry.†
11. Plum.†
12. Walnut—Chestnut.†
13. Hazel-nut—Filbert.†
14. Almond.†
15. Cocoa-nut.†
16. Melon.††

The above is a tolerably long and sufficient list of the fruits and edible seeds, which are usually procurable in England, and which are important from being in general use. The few wild fruits there are of native growth, and the dried fruits grown in warmer climates, must be separately considered.

Fruits have been classed by different writers, as —1st. Fleshy fruits, having the seeds enclosed in membranous cells: comprising the apple-genus;—2nd. Pulpy fruits, with the seeds interspersed among the pulp: the grape, the fig, the pomegranate, the mulberry, the currant, the gooseberry, the raspberry, the strawberry, the barberry, the elderberry, the blackberry, the bilberry, the cloudberry, the melon, &c;—3rd. Stone fruits, having the seed enclosed in a hard nut, which is covered with flesh: the peach, nectarine, almond, apricot, plum, cherry, and olive; —and 4th. Nuts, more strictly so called, of which the

external covering is neither fleshy nor pulpy: the walnut, the chestnut, the hazel nut. But some of the fruits, of warmer climates especially, are not quite fitly classed under any one of these four heads: such as the orange, the date, and the pine-apple.

With a view to the question of dietetics, the fruits might be appropriately arranged, according to their predominant characteristics, as the acid, the saccharine, the mucilaginous, and the farinaceous. In the colder regions of the earth, where fruit of any kind would be little fitted for man's sustenance, where a less diluted form of nutrimentary matter is indispensable to man's well-doing, and where the single use of fruit must be to correct the putrescent and acrid tendency of a highly animalised and gross diet, the fruits are of an acid character, only antiseptic, and in little or no degree nutrimentary. Such a fruit is the cranberry. On the other hand, in warm climates, where diluted forms of alimentary matter seem to be essential, to adapt the system and its supplies to the comparatively small expenditure, the fruits are either simply mucilaginous and aqueous, as the water-melon and the mango,—or farinaceous, presenting, however, a much diluted form of farinaceous matter, as the date, the bread-fruit, and the fig.

The grape is probably the most easily digested of all the fruits. That the fruit be ripe, and of good quality, is, however, essential to its deserving such a character. Those grown in the hot-house, at a carefully regulated temperature, fully matured and

ripened, are probably more easily digested, as well as characterised by a finer flavour, than grapes grown in the open air, in any climate whatever. Grapes contain sugar, gum, and gluten,—together with vegetable acid, chiefly in the form of bitartrate of potassa,—and a large proportion of water. They contain much more sugar than acid,—and are probably digestible in direct proportion as they contain a smaller proportion of acid. And it is the same with the other fruits: the more sugar and the less acid they severally contain, the more easily digested they generally prove to be. To accomplish the process, similar to that of fermentation, by which the acid and mucilage are converted into sugar, and which is the condition of the maturation or ripening, heat, and probably light, are requisite conditions; and well-ripened fruit, not damaged by wet, is seldom to be objected to, if the quantity eaten be moderate, and the more easily digested kinds are made use of; whereas unripe and unsound fruit is, in almost all cases, digested with difficulty, and apt to occasion dyspeptic symptoms.

The orange genus affords, as its four principal species, the orange, the lemon, the citron, and the lime. The juice of the former contains but little citric acid, and more mucilage and sugar; being, however, essentially aqueous, and holding very little of either sugar, acid, or mucilage, in solution. The other three species afford little sugar, but contain a large quantity of citric acid. As much as twelve ounces of the crystallised acid, appear to have been

obtained from a gallon of lemon juice; and it is a fair inference, that the whole of the citric acid was not obtained from it even then. An aqueous and cooling fruit, containing little acid, and but a small proportion of either sugar or mucilage, the orange is as grateful to the palate, as it is in most cases easily digested. The lemon, independently of its importance in warm climates, from its antiseptic and cooling properties, is a valuable addition to an oleaginous diet in colder regions, and is of much importance as a medicinal agent, and especially in the case of scurvy,—once the scourge of the navy, and now comparatively seldom seen, and still more seldom destructive to life. Preserved from speedy decay by their close skin and acrid rind, which is valuable in itself for the essential oil it affords, these fruits bear carriage peculiarly well, and are almost as important in these colder latitudes, as the fruits of native growth, or as they are in the countries which produce them.

The strawberry contains malic and citric acid, with sugar and mucilage. It contains, moreover, a peculiar essential oil, of much fragrance, which seems to affect and impair its digestibility in many cases. When perfect as to ripeness and quality, the strawberry is generally, however, sufficiently digestible. Its digestibility is impaired by its being either imperfectly ripened, or unduly acid,—and likewise, and very seriously, as is the case in wet seasons, when damaged and somewhat tending to decay.

The raspberry is of less decided character than

the strawberry as to acidity,—and certainly seldom disagrees so much as the strawberry does, in the few cases where that fruit always occasions dyspepsia. The raspberry is even more susceptible of decay than the strawberry.

The pine-apple is more fleshy, and contains a larger proportion of acid and sugar; it has a strong flavour, and is in general easily digested. When of hot-house growth, and perfectly matured and ripened, it is probably more digestible, as well as of better flavour and quality, than the fruit which is imported.

The currant and the gooseberry contain more acid, and less sugar, than the preceding fruits,—and are by so much less digestible. They are, however, in most cases, sufficiently digestible. They are probably natives of the temperate countries, and possibly natives of Britain. They are of better quality and flavour when grown in the cooler than in the warmer climates; and this is still more the case with the gooseberry than with the currant. The seeds and the skins are necessarily indigestible, and add mechanically to the risk of visceral disturbance from their use.

The stone fruits contain malic acid and sugar, with a considerable proportion of mucilage, and a small quantity of essential oil. The more aqueous and the less fleshy, and the more saccharine and the less acid they are, the more easily are they digested. These, for the most part native productions of warmer climates, are generally of better quality, more perfectly

matured, and more easily digested, when grown in the hot-house. Having stronger fibres or a harder pulp, and being more mucilaginous, than the fruits already spoken of, the stone fruits are much less easily digested, and much more liable to derange the digestive organs, than those fruits are. Even the peach, and its remarkable variety—the nectarine, and the apricot, the relative digestibility of which is probably in the order in which they are named, should be allowed cautiously, and in very moderate quantity, to the dyspeptic; the cherry is still less certain to be easily digested; and the varieties of plum (in all cases, still less easily digested), are less readily digestible in the same proportion as the fruit is more acid, less saccharine, less aqueous, and more fleshy,—the green-gage being the most easily digested, and the damson the least easily digested variety.

The fruits of the apple genus, affording malic acid, some sugar, and much mucilage,—the fruits being fleshy and of fibrous character,—are more or less easily digested, as they are more sweet and aqueous, and less acid. The digestion of either the apple or the pear, even when of least objectionable quality, must be said to task somewhat the powers of digestion; although,—inasmuch as these fruits are free from essential oil,—they are otherwise less apt to irritate the digestive organs, than the individuals of the plum tribe. Cooking affects very much the digestibility of these fruits; and in much greater degree than that of most other fruits; — pro-

bably from dissolving or softening the vascular fibres. Whether roasted, baked, or boiled, cooked pears and apples are almost always much more easily digested than the raw fruits. Most fruits are rendered more easily digested by being cooked; although this is more the case with the characteristically fibrous fruits, as apples, than with the more simply acid, or saccharine, or mucilaginous fruits. Baked and roasted fruits deserve the first place in the scale of relative digestibility; stewed fruits rank next to these; and then, boiled fruits. The drier the cooked fruit is, the more likely it is to agree with the stomach. It is not wise, for this reason, to drink water while eating, or soon after eating it; or to mix any liquid with it. And, on this account, apple tea, black currant tea, lemonade, orangeade, &c., are not by any means so likely to agree, as might *à priori* be supposed; nor, in general, are they so likely to be digested without inconvenience, as the fruits themselves.

The whole of the fruits of the nut tribe contain a large proportion of fecula; and a greater or less, but generally a large, proportion of oil. The fibres are hard, and usually digested with some slowness and difficulty, which is necessarily added to by their oleaginous character. The less oily the nut, and the less hard the fibres, the more easily it is digested. The chestnut, when roasted, or otherwise cooked, and its fibres therefore softened, is often sufficiently digestible. Chestnuts appear to have been much more

used in former times in this country, than they now are. In the southern parts of Europe, they are said, even now, to form an important article of food to the common people. Even the roasted chestnut is, however, in general, necessarily forbidden to the dyspeptic. The filbert, or cultivated variety of hazel nut, is more easily digested, than its uncultivated prototype. The recently gathered fruits of the nut tribe are more easily digested, than when they have been kept, and have become harder and drier. This is particularly noticeable in the case of the cocoa-nut, which is, in this country, so remarkably difficult of digestion; whereas it is said to be much more easily digested, when recently gathered.

The melon is even peculiarly apt to derange the digestion; perhaps chiefly from its watery and refrigerant character, but partly from containing a peculiar and characteristic oil. That the fruit be ripe, and the fibres perfectly tender, are of much importance to its digestibility; and it is usually quite needful that a moderate quantity of some generous wine should be taken along with it, to correct its peculiarly aqueous and refrigerant properties. The melon affords a good instance of the different effects of food, in different climates. It seems, that all the aqueous and refrigerant fruits are eaten largely in tropical countries, not only without discomfort or derangement, but with much and evident advantage to the health; whereas they often disagree, and prove to be by no means suitable, when made use of in the colder latitudes.

It would be well, if the invalid were to abstain from eating those fruits, that require the addition of sugar to render them palatable; yet there can be no question, that such fruits are more wholesome when eaten with sugar, than they would be without it.

The addition of cream increases materially the difficulty with which fruit is digested. Although it may pass through the stomach without disturbing its functions,—the probability is, however, that, in the case of the invalid, this will not be so,—such a mixture will seldom pass through the bowels, without manifesting some sign that it has disagreed.

The wild fruits grown in this country, are, in general, objectionable, either from their extreme acidity, or from their being more viscid than the cultivated variety of the fruit. The more important of these are—the cranberry, the barberry, the bilberry, the brambleberry or blackberry, the raspberry, and the strawberry;—and to these may be added, the elderberry,—and, although rarely found in our moorlands, probably from their being generally sheep-pastures, the cloudberry. The objections to the cranberry are, its extreme acidity, and the peculiarly tough and therefore indigestible skin. In extremely cold countries, it may probably have much value, as an antiseptic addition to the strong and oleaginous articles of food. The barberry is likewise extremely acid, and is only used in the form of pickle or confection. It has a very purely acid taste, and is proportionably palatable when well qualified with syrup. The bilberry, the abundant

growth of our moorlands, contains little acid, and has a much thinner skin than the cranberry. It contains a peculiar flavouring principle, probably oleaginous, which disagrees with some people, and seems to be distasteful to many. The bilberry, appears, however, to be usually as little objectionable on the score of digestibility, as any of the wild fruits, if not less so. The brambleberry, or blackberry, the common growth of the English hedge-rows, is more objectionable from its viscid character, than from its acidity. It contains a fair proportion of saccharine matter. It appears to derive no advantage from cultivation. The wild raspberry and wild strawberry are well known to have more flavour than the cultivated varieties. The wild varieties are more acid, and usually have more viscidity. The strawberry owes much more to cultivation, than the raspberry. In a congenial soil and climate, as in the plantations near Buxton, the wild raspberry may be found as large, and of a much finer flavour, than the garden fruit.

The elderberry is principally used to form the staple of a highly spiced wine, which used to be much valued as a winter beverage. That it supplies a grateful way of swallowing the aromatics, is, perhaps, the most that can be said in its favour. The acidity of the fresh fruit is due to malic acid. The fresh fruit, moreover, contains a purgative principle, which is apt to nauseate the stomach, if the fruit be eaten in substance. From half an ounce to an ounce of the juice, is said to be a moderate purgative.

This aperient quality is, for the most part, lost, in the process of fermentation, and is not found in the elderberry wine. The flowers of the elder are noted for affording an agreeable aromatic flavour, like that of the Frontignac grape, which they yield in distillation to water, or impart by infusion to vinous and spirituous liquors, and to oils.

Of the cloudberry we know very little in this country; it being chiefly remarkable for its rarity, and the extreme beauty and lustrous character of its colour. Its name implies its attachment to elevated and exposed situations. It is said to be of much value and importance in Sweden and Norway; being, indeed, in those countries, an article of extensive commerce, and a much used and important fruit.

The foreign dried fruits are of much and increasing importance. They are principally the fig, the raisin, the *so called* currant, and the plum. They generally acquire sweetness, and lose acidity, during the drying.

Dried figs contain, besides the sugar, a considerable proportion of farinaceous or mucilaginous matter. In former times, among the Hebrews, the Greeks, and even the Romans, the fresh fig was an important article of diet to the population; and it appears, from its easy cultivation, great fruitfulness, the wide range of latitude in which it flourishes, and from the double or even treble crops of fruit which it yields every year, to be well suited to occupy so large and important a position. As in the case of many others of the farinaceous fruits, the cultivation of the dif-

ferent plants belonging to the Cerealia has much circumscribed, and considerably lowered, the importance of the fig as an article of food, even in the countries where it thrives most luxuriantly and easily. As regards the dried fruit, it is considered to possess aperient properties, which are chiefly to be attributed to the mechanical action of the insoluble seeds and skin upon the bowels; and these necessarily render it liable to irritate and derange the digestive organs, where the mucous membrane is irritable, or morbidly sensitive.

The raisin, or dried grape, is usually rather more acid, somewhat less saccharine, and decidedly less mucilaginous, than the dried fig. When recently dried, they are more easily digested, than when kept a longer time; but the insolubility of the skins makes them objectionable to the dyspeptic, whether eaten alone, or mixed with puddings, or with bread. The same remark applies, in some degree, to the dried currants,—which are, more strictly speaking, a small seedless variety of grape. But the objection to these is less strong, inasmuch as the skins of the dried currants are thinner, and by so much less apt to irritate. The dried plum is more viscid than any of the others, and by so much less digestible than they are.

The dried fruits are so generally considered to be comparatively easily digested and harmless, and consequently are so apt to be eaten by invalids and dyspeptics, that the necessary insolubility of the skins,—the objectionableness of some on account of

the seeds, and of others on aecount of the viscidity,—require to be fully impressed on the mind, and steadily enforeed. Dried eurrants or plums ought seldom, if ever, to be eaten by the invalid, or to be put into his pudding or his bread; and yet this is a eommon practiee, to add to the palatability of either; or, in the ease of bread, to form what is erroneously supposed to be a harmless substitute, when the dyspeptic finds himself obliged to refrain from the use of butter.

For the same reason, if the preserved fruits are to be allowed to the sick or the dyspeptie (a praetiee, by the way, that is by no means always judicious), it is well to prefer jelly, or the juiee and pulp made into a confection with sugar, to jam, in which the skin and seeds are likewise present. Preserved fruits may be objectionable, on account of the large quantity of sugar they eontain, or on account of their acidity, or from the viseid character of the fruit they are made from. Probably the most grateful and wholesome of them all is the marmalade, made from the bitter orange,—espeeially when made of sugar and the juiee of the orange, with *an infusion* of the rind,—the rind itself not being used. This is sometimes usefully allowed as a substitute for butter, and without disadvantage or inconvenience: the aromatic bitter probably soothing, and giving some degree of tone to the stomach. But this, and all the varieties of preserved fruits, are improper for the seriously afflicted dyspeptic or invalid.

The leaf-stalks of rhubarb, from their character, and the mode of using them, should be considered under the same head as fruits, in treating of dietetics. When stewed or baked, they form a very grateful, and generally a sufficiently digestible article of food. They are lightly acid, and aqueous,—having little sweetness or viscidity. The medicinal species of rhubarb is cultivated by some people, on account of the more laxative properties of its leaf-stalks,—which are used by them, as those of the more commonly cultivated species are by the generality of people. These leaf-stalks are not so palatable as those of the common rhubarb; but they are not decidedly unpleasant to the taste; and their use in some habits of body is not unattended with benefit.

VEGETABLE PRINCIPLES.

1. Starch. 2. Gum. 3. Sugar.† 4. Oil.†

These are, severally, of much importance, from being so extensively used as articles of diet in their separate forms, as well as from constituting the greater part or bulk of the nutrimentary portions of the different vegetable productions, which are used as food. They are characterised by great similarity of composition,—by the ready conversion of either starch or gum into sugar,—and by their being non-azotised articles of food, and therefore ministering exclusively to the respiratory wants of the animal system. The composition of starch (carbon 12, hydro-

gen 10, oxygen 10,) differs very little from that of gum (carbon 12, hydrogen 11, oxygen 11); and the analysis of gum gives precisely the same results as that of cane sugar. The ready conversion of starch and gum into sugar, finds from this a ready explanation. The much greater difficulty with which sugar is digested and assimilated, is not so easily explicable; although it may admit of an approximative explanation.

Starch is diffused universally throughout the vegetable kingdom. It occurs in seeds, as in those of the Cerealia and of the Leguminosæ,—in roots, as the potato, turnip, &c.,—in pith, as that of the Sagus Rumphii (sago),—and in fruits, as the apple, fig, &c.

Starch is chiefly obtained from wheat-flour (common starch); from the tubers of the potato (potato-starch); from the root of the Jatropha manihot (tapioca); from that of the Maranta arundinacea (arrow-root); from that of the Orchis mascula (salep); and from the pith of the Sagus farinifera Rumphii (sago). The whole of these varieties differ in no great degree from one another, either in composition, digestibility, or nutritive qualities. Starch is formed in granules, having the appearance of minute particles, even to the naked eye; and which microscopic examination shows to be small rounded bodies, having no trace of crystallisation. The size of these granules is evidently determined by that of the organised cells in which they are formed,—varying in different plants; the granules being largest in the starch obtained from the potato,—much smaller in that from

the Leguminosæ,—those from the Cerealia being the smallest. These granules are not affected by being immersed in cold water. Each granule appears to be secreted in a semi-fluid state; the excess of water being afterwards removed. The granule is covered by a smooth integument, which is less readily soluble than the contents. Starch yields a certain proportion of phosphatic salts, on destructive analysis; which appear to be the chief, if not the sole, appreciable difference in chemical composition, between starch and sugar; the great difference between them being possibly referable to some polarising influence of the adventitious salts, on the arrangement of the atomic molecules with reference to one another. When heated with water, the integuments of the particles are influenced and softened; the granules swell; and a mucilage or viscid mass is formed. If free iodine be added to the mixture of starch and water, a deep-blue colour is formed,—supposed to be owing to a mechanical division of the iodine, and its adherence to the particles of starch, in the same way as a dye-stuff adheres to cloth. If the mucilage formed by the mixture of starch with boiling water, be heated with any substance containing nitrogen, and in a decomposing condition,—or, in fact, with its molecules in a state of change or of movement, such as a strong infusion of malt,—the starch undergoes a further and greater change, the particles are broken up, and the resulting product, now called *dextrine*, no longer gives the peculiar blue colour on the addition of free iodine; and dextrine resembles gum in

its appearance, differing from it, however, in the remarkable facility with which it is converted into sugar. Whether the dextrine be virtually pre-existent in the granules of starch, and detached by the bursting of the less soluble integumentary matter, may be a doubtful, but is probably an unimportant question. The rupture of the granules, and the change of the physical and chemical characters, are interesting results of the addition of a nitrogenised and fermentative matter,—results which are aided by pressure, or other mechanical means of breaking down the grains; and the consequent and remarkable convertibility of starch into other forms, is a phenomenon which helps to illustrate, in an important degree, not only the processes by which fermentation produces such great changes out of the body, but those by which the action of the saliva, and that of the proper gastric juice, may subserve the great purposes of converting the different alimentary matters into a chyme, that is suitable for the nutrition of the body. Starch, gum, and sugar, are all essentially composed of carbon, oxygen, and hydrogen; the two latter constituents being probably in the proportions necessary to form water, although the relative quantities of these and carbon vary considerably in these different vegetable products. And, indeed, the different varieties of starch contain different proportionals of the hydrogen and oxygen; or as it may be said, for the sake of intelligibility, of constituent water: that is, of water which cannot be detached from the substance without destroying it altogether. For starch con-

tains, from whatever source obtained, a large quantity of water, which is not essential to its composition, and may be driven off, by a carefully managed and moderate degree of heat, without injury to it. Independently of this adventitious water, the proportion of component water (or of oxygen and hydrogen), that is in union with carbon, varies much, in the different modifications of this important vegetable principle; and the starch is said, in the language of Dr. Prout, to be *stronger* or *weaker*, accordingly: the interesting result being, that the weaker the form of starch, or the more of component water and the less of carbon it contains, the more easily it is digested. Arrow-root is at once the weakest and the most easily digested form of starch. The same curious and interesting fact will have to be noticed, when speaking of the varieties of sugar: the weaker, or more aqueous, the form of sugar, or the less the proportion of carbon, the more easily it is digested, and the less definitely crystalline its character;—crystallisation being a characteristic of inorganic, and not of organised matter; and one which shows the substance to be less assimilable, and with more difficulty made to enter into the composition of the living organism. And these facts are admirably cited by Dr. Prout, in illustration of one of his great positions: that a primary step in assimilation is to reduce the food in chemical character, by the addition of component water to the molecules, and so prepare it for the vitalising influence of the assimilating organs, —bringing the molecules more within the influence

of modifying agencies, and removing them from that of their affinity for one another. Oleaginous substances illustrate the same interesting position; containing, as they do, a large proportion of carbon, they are with difficulty assimilated, unless the system is in circumstances to require, and expend, a large proportion of carbon; and they are relatively digestible, very much according to the degree in which the proportion of water is greater than that of the carbon, or as the oil is weaker or more strong.

Arrow-root is obtained chiefly from the root of the Maranta arundinacea. The roots are crushed and reduced to a pulp, the fibrous parts separated and thrown away, and the starchy particles mixed with water, and repeatedly washed, and allowed to subside, the water being drained off; the arrow-root being eventually dried in the sunshine, upon cloths, and being then fit for use. It is an article of much value; and more peculiarly so, from its ready digestibility, and little likelihood to irritate the digestive organs, or tax them unduly for its assimilation. It is, of course, by no means a substitute for the azotised articles of food: and can never be more than an auxiliary to them, in the nutrition of the body; or more than a respiratory aliment.

Sago, obtained from the pith of the Sagus farinifera, is an important and grateful form of the amylaceous principle. Growing wild and without culture in congenial climates, attaining a considerable height and girth, having a large central pith mainly composed of starch, the Sagus farinifera furnishes the

staple food of the population of some parts of the world. A single tree is said to yield from two to four hundred weight of the starch. The farina is brought into the granulated state in which it is sent to Europe, by being moistened, and passed through a sieve, into an iron pot, held over a fire. To this partial cooking, the easy preservation of the granulated sago is said to be owing; the powder when uncooked, turning sour very soon.

Tapioca, obtained from the root of the Jatropha manihot, is a palatable and easily digested form of starch. The root is said to be peeled, then ground or grated; the pulp being separated from the juice, which is poisonous, by pressure in bags; the farina being then baked, on a hot hearth, or an iron plate.

Salep, chiefly the produce of the Orchis mascula, is obtained from the root of the plant, which is cleaned, peeled, baked, and dried. It contains a gummy matter, which is probably peculiar to it, and to the viscidity of which it seems to have been indebted for the reputation it used to enjoy, of being more nutritious than the other forms of starch.

Gum is an abundant and important vegetable product, although not by any means so much so as starch. Almost identical with starch in chemical composition, it differs from it in not being formed in granules, or not having its particles contained in capsular integuments, and in being therefore soluble in cold water. Pure gum yields 2 or 3 per cent. of earthy matter, consisting chiefly of carbonate of lime;

and in this respect chiefly, differing from starch on the one hand, and sugar on the other. The less pure gum, as that obtained from linseed, is said to leave 11 per cent. of ashes, which are chiefly composed of lime, either in the state of phosphate or in that of carbonate. Like starch, gum is readily convertible, by long boiling with diluted sulphuric acid, into the weaker form of sugar, or grape sugar.

The purest form of gum is obtained from a species of Acacia. It exudes naturally from the bark of the trunk and branches of the tree, in a nearly fluid state, and hardens without losing its transparency. This —the gum Arabic of commerce—is of little importance in the question of diet, probably on account of its cost; although it is much used as a demulcent for medicinal purposes, and affords a bland and easily digested article of food.

A cheaper, but much less pure, form of mucilage, is found in linseed,—the seed of the Linum usitatissimum—the common flax. By expression, the seeds yield one-sixth part of their weight of fixed oil; and they contain, moreover, a principle, which is insoluble in water, and resembles the substance called Bassorine—the chief and essential ingredient of gum tragacanth. If boiled in water, the seeds yield some of the oil, as well as the purer gum; and hence the decoction differs from the infusion of linseed, in being more or less oleaginous.

The Iceland moss, the plant of the Cetraria islandica, yields to water a large proportion of mucilaginous matter; which, however, is not, strictly speaking, a

gum, but rather resembles a mucilaginous substance that is obtained from the root of the Inula helenium (Elecampane root), and hence called Inulin. Besides the mucilage, of which it seems to yield at least 40 per cent., Iceland moss contains 3 per cent. of a bitter principle, which may be separated, in a great degree, by boiling the plant for a short time, after macerating it in several portions of cold water,—the boiling water being poured off, and the mucilage being obtained by a much longer decoction. The bitter principle, however, may or may not be objectionable, according to circumstances. Of course, if simply used as an article of food, the bitter principle is advisably extracted and separated, as far as possible. There is another species, sold as Irish moss, which does not contain the bitter principle, and may or may not be preferred on that account. Both kinds are chiefly used by invalids, and for the sake of their demulcent qualities.

Besides the sugar of milk, already taken notice of (p. 118), there are two principal varieties of sugar, which differ from one another, in an important degree, in their chemical characters, and somewhat even in their composition. They are cane-sugar and grape-sugar.

Cane-sugar is obtained from the sugar-cane, from beet-root, from the maple, &c.

When the sugar-canes have attained a certain height and age, the cuticle having become smooth, dry, and brittle, they are cut, stripped of their leaves, and crushed between rollers to express the

juice, which is mixed with lime, to saponify, and render more liquid and separable, the molasses, or liquid and uncrystallisable sugar, commonly called treacle. The juice is now heated to the temperature of 140°, and separated from the scum, and again heated several times, and at length allowed to drain, for the separation of the molasses, and the crystallisation of the sugar. The raw sugar thus formed is again purified, by being dissolved in lime-water, mixed with bullock's blood: the one serving still more to separate the molasses,—the other, by the coagulation of the albumen, effecting the clarification, and mechanical separation of any foreign insoluble matters. Reduced to a certain syrupy consistence, the sugar is poured into moulds, and agitated for a certain time, to prevent the formation of large crystallisations, and secure a compact mass of closely adherent, small, and glistening grains; the quality of the sugar depending greatly on the lowness of the temperature, at which the boiling has been effected. Sugar is obtained and refined by the same processes, from the sap of the Acer saccharinum, or sugar maple, and from beet-root. When the refined sugar is left to crystallise slowly, at a somewhat elevated temperature, sugar-candy is formed; or if the melted and viscid mass is left to cool more quickly, a transparent solid form is obtained, known as barley-sugar.

The other variety of sugar, called grape-sugar, from existing in the juice of grapes, and many other fruits, is likewise contained in honey, and is the

product of the fermentation of starch and of gum; and even cane-sugar is reduced to this form of saccharine matter, when subjected to the action of a ferment,—and is probably likewise so reduced before it can be assimilated by the digestive organs.

Grape-sugar is essentially a weaker form of sugar than cane-sugar: that is, according to the view of Dr. Prout, contains a larger proportion of component water. The composition of cane-sugar being stated as, carbon 12, hydrogen 9, oxygen 9, + 2 hydrogen and oxygen,—that of grape-sugar is, carbon 12, hydrogen 11, oxygen 11, + 3 hydrogen and oxygen,—containing, accordingly, so much more of combined water. Grape-sugar contains about 7 per cent. more of component water than cane-sugar. By boiling with diluted sulphuric acid, cane-sugar is converted into grape-sugar.

The three varieties of sugar differ very much from one another, as to the degree of their solubility in water: cane-sugar dissolves in one-third of its weight of cold water, and in any quantity of boiling water; grape-sugar likewise dissolves in any quanity of boiling water, but requires one and a-half times its weight of cold water for its solution; and sugar of milk requires five or six times its weight of cold water, and two and a-half times its weight of boiling water, to dissolve it.

Grape-sugar is much less sweet to the taste than cane-sugar; and its syrup is not nearly so viscid. Although cane-sugar is so easily converted into grape-sugar, and although the formulæ of their

composition only show a difference in the number of the equivalents of component water, they differ very much from one another in their chemical properties. The strong mineral acids immediately decompose cane-sugar, but appear to have little effect on grape-sugar. On the other hand, the effect of alkalies, although little on cane sugar, is of a marked and decided character on grape-sugar: converting it into dark-coloured compounds. Even when vegetable juices containing cane-sugar are evaporated, the presence of organic acids in such juices causes the cane-sugar to be more or less converted into grape-sugar; and then, when lime is added, to clarify the juice, the action of the lime is to produce melassic acid,—making the sugar so far dark and uncrystallisable, and converting it in the same degree into molasses. This loss has to be avoided, by carefully neutralising the lime with sulphuric acid, as soon as it has answered its purpose of clarifying the sugar.

To obtain grape-sugar from starch, one part of starch is boiled with four parts of water, acidulated with sulphuric acid to a certain minimum or maximum degree, for thirty or forty hours; the acid is then neutralised with chalk, and the solution of sugar filtered from the little soluble sulphate of lime, and evaporated. In the process, the starch combines with four equivalents of water; so that there should be about a fifth greater weight of sugar obtained, than that of the starch employed. By the same means, grape-sugar may be obtained

from cane-sugar, or even from woody fibre, or from the third variety of sugar—sugar of milk; cane-sugar requiring three equivalents of water; woody fibre, six equivalents; and sugar of milk, two equivalents, for their conversion. The same result is produced, and much more quickly, by adding to starch, infusion of malt,—containing as it does, diastase, so often mentioned as a peculiar substance, in a state of movement, decomposition, or change; the result being probably due to a true fermentation.

The third variety of sugar, the sugar of milk, has already been alluded to. Like grape-sugar, it is susceptible of vinous fermentation, whether converted in the first instance into grape-sugar, or not.

On the principle of being crystallisable, and therefore as far as possible removed from the influence of organisation, and, as nearly as may be, assimilated in properties to those of inorganic matter, sugar might be supposed, *à priori*, to be digested with some difficulty. If to this, the preliminary step of reduction to a weaker sugar, in the case of cane-sugar, be added, the reason why sugar is so apt to derange and over-task the digestion, may appear to be sufficiently explained. But whether this be granted or not, sugar in its pure state is by no means easily digested; although it is probably sufficiently easy of digestion, when diluted and mixed with the juices, &c., of the plants from which it is obtained. As far as furnishing a supply of the respiratory carbon, and for the renewal of the fatty tissue, sugar is a nutritious article of food, if the condition of its

being digested be secured. It can by no means, however, be sufficient to sustain existence, without some azotised article of diet.

It is a doctrine of sufficient dietetic importance to justify repetition again and again, that, with few exceptions, the digestion and assimilation of pure substances, or separated vegetable principles, is more difficult than that of these same principles, when combined with other vegetable matters, as they exist in the juices, &c., of plants, or when less altered from the state in which they exist naturally. Pure sugar is unquestionably less easily digested than honey, this than whey or other simple and natural forms of the saccharine principle, this than the uncrystallisable form of the amylaceous principle—starch.

Even in the case of starch, simple and little irritating as it usually is, and readily enough digested, the weaker form of arrow-root is certainly more easily digested than the stronger starch, obtained from wheat flour; and even arrow-root is often found to be less easily digested, by people of very feeble digestion, than the farina of many of the grains, in which the starch is diluted and combined with other vegetable principles. Casein and butter, generally sufficiently digestible, when in the natural, weak, and mixed state of milk, are with much more difficulty assimilated when separated from it. And yet, even butter, although a fatty, and a highly oleaginous matter, is not a pure oil, but consists of certain mixed fatty matters, in combination with several organic acids and casein; and butter is, pro-

bably in the same proportion as it is a less pure oleaginous matter, more easily digested than pure oil. The same principle holds good in almost every example that the articles of diet afford, and is well worthy of being held to be of much practical importance: for instance, the separated organic acids are decidedly more likely to derange the digestive organs, than the same acids when in combination with other matters, in the fruits, &c., from which they are obtained. This view may assist in the explanation of the effect, that the weak form of the oily principle, alcohol, has upon the digestive organs; and it may help to explain the long observed difference between the effect on the assimilating and expending organs of the body, of the mixed and less pure forms of alcohol, as existing in wine and beer, and that of the purer and stronger alcohol, obtained from these by distillation, and used as brandy, whiskey, &c.

Molasses or treacle, the uncrystallisable portion of sugar, contains more component water, and is more easily digested, than sugar. It is usually somewhat laxative in its effects; and when sufficiently so, this property often corrects any ill effects on the system it might otherwise have. It is still, nevertheless, saccharine matter, and is still apt to irritate the digestive organs, and by so much to interfere with, and derange the processes of, ultimate assimilation.

Honey is likewise a weak form of sugar. It is, moreover, a compound substance: containing aromatics, and acids, &c.; and having even more of the laxative property than treacle, is still less apt than

treacle to interfere with the assimilating processes. It is probably digested more easily, when only imperfectly freed from the wax of the comb, than when quite pure. In most cases, the more aromatic the honey, the more easily it is digested. Honey is said to consist of a mixture of cane and grape sugars, with the addition of mucilage, wax, and essential oil. It is probable, that this comparatively weak form of saccharine matter, rapidly and easily undergoes such chemical changes, as leads to the partial conversion of the one form of sugar into the other. Like treacle, honey often acts as a laxative, and to a greater degree. But, like all other concentrated forms of saccharine matter, the digestibility of honey is only a comparative question; and although honey may be much less apt to derange the functions of assimilation than cane sugar or treacle, it is nevertheless by no means easily digested, when the stomach is either weakened, or otherwise less equal to its duties; and should always be used cautiously by the dyspeptic, if used at all by them.

The cloying effect on the palate and appetite of all the purer forms of the amylaceous principle, showing their less adaptability to the influence of the saliva, and to the susceptibility of the mucous membrane, is a primary indication of their comparative unsuitableness for staple articles of food; an effect which is diminished, in direct proportion as these non-azotised articles of diet are in a less crystallisable form, and in direct proportion as they are less pure, and more diluted with azotised and earthy

matters. Even the different forms of starch made use of as food, although useful from proving so little irritating to the organs of assimilation during their passage through the stomach and bowels,—and even so little irritating in some cases, where they prove to be in a great degree indigestible, passing through the bowels and out of the system without having undergone any appreciable degree of change,—are not to be considered as being digestible in the same proportion as they prove to be little irritating, nor is their occasioning little or no sensible inconvenience, or dyspeptic symptoms, to be considered, as in any degree marking their suitableness to the assimilating powers of the digestive organs, or their capability of being converted into respiratory carbon, or into the adipose tissue of the system.

I cannot help believing, that this has been a frequent source of error. There is no doubt, that all the forms of the amylaceous principle, if capable of being digested, are largely useful to the economy, in supplying the carbon required for the purposes of respiration,—and in supplying the adipose matter of the body, which is essential for so many of its wants and processes, and is capable besides of proving a reservoir for the respiratory carbon, into which it may at any time be converted, to meet the wants of the economy. The whole question, of course, rests on the non-azotised articles of food being digested; and the probabilities of this are less, in the same proportion as they are pure,—unmixed with the azotised articles of diet. To this, in the case of

the saccharine variety of the amylaceous principle, has to be added their directly irritating effect on the *primæ viæ*, if the assimilating functions are not equal to their conversion into chyle.

The digestibility of sugar, and its chance of irritating and deranging the digestive processes, by no means cease to be interesting when it has passed the stomach, or even when it has partially undergone what has been called the second stage of the digestive process. Saccharine matter is still apt to occasion irritation, to lead to the secretion of an abnormal quantity of acid matter from the stomach and bowels, to rob the system of alkaline matter for the neutralisation of the excessive or morbid product, and thus to derange the ultimate processes of restoration and waste in the economy, and give rise to various forms of disease.

The difficulty with which sugar is assimilated, is not affected, or not affected materially, by mixing it artificially with other articles of food. It is still cane-sugar, has still to be converted into the weaker form of saccharine matter before it can be digested, is still crystallisable, and is still a pure vegetable substance, and as such is still as foreign as may be to the constitution of the animal organism. Although honey is so much more easily assimilated than cane-sugar, and is so by virtue of containing a larger proportion of combined water, this water is in a state of chemical union with the other constituents, and cannot by any of our processes be separated from them, without total destruction to the honey. On the

other hand, mix and dilute sugar as we may with other articles of food, or with water, the sugar is readily separated from them again, and reproduced in its pure and crystallised form. We can separate the starch from the fibrin of the wheaten-flour, and obtain a product, which, although less easily assimilated than flour, is likewise less likely to irritate the stomach and bowels; but we cannot combine the starch and the vegetable fibrin, to form the wheaten-flour again. In the natural state, the vegetable principles are mixed and diluted with one another; and are, moreover, diluted and weakened, by having a larger or smaller proportion of combined water; and are thus in a state to be more easily assimilated, than they are found to be in the purer states, in which they have been separated by means of art.

Olive oil, so much used in continental cookery, is another important illustration of this fact. Although probably only inferior to fresh butter in digestibility, when compared to any other form of oleaginous matter, olive oil is, nevertheless, too much used in foreign cookery, to render their dishes as easily digested, on the whole, as our own are found to be; notwithstanding their admirable concoctions, and reduction of food to gravies and jellies, and the little labour of solution left for the gastric secretions to perform.

Vinegar, another form of the crystallisable articles of diet, is likewise digested with difficulty, and apt to derange the functions of assimilation, and so far to interrupt, or retard, the digestion of other articles of food, or to disturb the ultimate processes of expendi-

ture and restoration in the economy; and yet there is no doubt, that the less pure form of acetic acid offered in the vinegar made from wine, is more easily digested in itself, and is less apt to inconvenience the economy of the system, than the purer form of acetic acid obtained from the distillation of wood, or by other means. The true theory of the conversion of wine or beer, or rather of the alcohol contained in them, into vinegar, appears to be that of a slow combustion of the alcohol, either by means of the ferment contained in those liquids, or, in the case of pure alcohol, by the addition of a ferment, or substance containing azote, and in a state of movement or change, and the consequent addition to the atomic constitution of so much more oxygen. The effect of vinegar upon the digestive organs, is, however, infinitely different under different circumstances. In the case of the food being oleaginous, to an important degree, there is no doubt that vinegar promotes its digestion, and to a very considerable extent; and under such circumstances is desirably made use of. And again, in the case of the food being of putrescent character, there is equally little doubt that vinegar answers an important purpose, by virtue of its action as an antiseptic, in diminishing or averting danger to the economy; although, possibly, by no means to the extent, that this important purpose is answered by citric acid.

Of the condiments generally, to which class vinegar may very fairly be considered to belong, salt is the most important, and indeed essential, to the economy. By virtue of its chlorine, this important

substance largely promotes the functions of the stomach and bowels in assimilating the food; by virtue of its soda, it greatly subserves the uses of the bile in the economy; and in every way, its action,—whether by means of its separated constituents, or in its combined state, serving probably to maintain the blood in its singularly compound and yet homogeneous condition,—is shown to be great, on all the functions and conditions of the body. There can be no question, however, that even salt may be too much or too little used in the food: that in the one case, the tissues and the expending organs are too much stimulated; in the other case, the system is unduly, and not without serious risk, deprived of that agent, by which so large a share is performed in the nutrition of the body; and which in itself, by its ultimate elimination from the body in the several excretions, probably serves to keep up the action of the excreting organs, and promotes the disintegration and throwing off of the effete matters, no longer fitted for the purposes of the economy, and which could not be retained without injury. The less readily assimilated the articles may be, and the less of saline matter contained in them, the more essential is salt as a part of the diet; and hence the oleaginous articles of food, and the purer forms of the amylaceous principle, when largely used as the means of nutrition, require usually more salt to be eaten with them, than the more ordinary and less pure forms of vegetable or even animal diet. And yet animal diet of any kind, probably from its

putrescent tendency, if not mixed with vegetable food in sufficient proportion, is found to require a large mixture of salt with it, for the maintenance of health and strength.

The various spices are more or less important to the food of man, in proportion to the circumstances in which he is placed. They seem to be more important in warm climates, or under circumstances calculated to relax and depress the powers of the system. They all depend for their effects on the presence of peculiar essential and volatile oils, which differ from other essential oils, as oil of turpentine, in containing a small proportion of oxygen. The plants which yield these stimulating additions to our articles of food, are all the growth of tropical countries. The spices are conveniently divided into those which are simply hot and acrid, and those which have a sweet and aromatic flavour besides. The simply acrid spices are probably less apt to derange the economy than the aromatic spices. Common pepper, the seed of the Piper nigrum, and cayenne pepper, the pod of a species of Capsicum, are the principal examples of the simple or merely acrid spices used in this country. The other spices are probably more likely to agree, as they have less sweetness and aroma, in addition to the acridity. They are all, no doubt, valuable as well as palatable additions to the articles of food, promoting digestion directly by their action as stimulants, and indirectly by ministering to the palate. They are, however, on this account liable to be too much made use of,

and are, beyond question, used unduly; and more especially in cold and dry districts, in which the risk of over stimulating the system is greater, than in hot or humid, and therefore relaxing localities. These, and all stimulants, excite for a time: rousing the organs into greater activity, increasing the amount of the secretions, and temporarily augmenting the organic powers, and especially those of the stomach. But languor and exhaustion are almost sure to follow even a single instance of their immoderate use; and taken habitually, they are certain to produce, indirectly, debility, and weakened action of the several functions,—particularly, and usually in the first place, of those of the stomach. They should be used, therefore, with much moderation. Exciting, in the first instance, the action of the stomach, and temporarily increasing its powers, their ultimate effect is to weaken and impair its functions.

Carraway seeds, obtained from the Carum carui, perhaps deserve to be pointedly mentioned, on account of their grateful effect on many dyspeptic stomachs. They are probably little liable to abuse, and form a palatable and not unwholesome addition to the invalid's bread or biscuit.

The use of spices and condiments, however, of all kinds, salt alone excepted, should be moderate and careful. The more deranged the processes of assimilation, the greater the morbid sensitiveness of the stomach, the more acrid and morbid the gastric secretions, the more likely are all the carminatives to be injurious. In the atonic state of the digestive

organs, whether engendered by hot climates or otherwise, their use is, no doubt, of some occasional service; but they are apt in the end to add to the evil, by leaving additional real debility as a consequence of the artificial stimulation, and should be made use of accordingly with as much moderation as may be.

Pickles are liable to whatever objections may be combined under the several heads of vegetables, vinegar, and spices. They may be sometimes needful stimulants, and valuable antiseptics; they are more usually provocatives to appetite, and unwisely stimulating to the digestive organs; probably often occasioning the formation of an imperfectly assimilated chyme, causing the *ingesta* to be propelled in a somewhat crude state into the bowels, and eventually deranging the ultimate assimilation, although possibly facilitating the primary processes of digestion.

Unless for the sake of completeness, the seasoning herbs might seem to be almost unnecessarily mentioned. Used, in general, in too small a quantity, to make their digestion a matter of much importance,—containing, moreover, sufficient of the aromatic principle to secure their own assimilation, in most cases,—and yet being too weakly acrid and aromatic to have much stimulating effect,—they need seldom be forbidden in the broth, soup, or pottage, prepared for invalids, and are not in themselves for other reasons objectionable. Parsley, horse-radish, the three species of mint, thyme, sage, marjoram, balm, &c., the more important, and more commonly used of

these herbs, are all, in themselves, in most cases, sufficiently unobjectionable, unless in cases of idiosyncrasy. If mixed with less digestible substances, as in the case of all the various forms of what cooks are pleased to call *stuffing*, they are to be forbidden to invalids and dyspeptics, as interfering with the digestion of other viands, in an important degree. Some of these are probably too much neglected in these days; and perhaps especially parsley, balm, and the mints;—affording, as they may often do, grateful, and not seldom very useful beverages to invalids,—and at all events affording a palatable medium, by which a large amount of diluent matter may, under some circumstances, be introduced into the system, with much advantage.

1. Tea. 2. Coffee. 3 Cocoa.

"We shall never, certainly," writes Professor Liebig, "be able to discover how men were led to the use of the hot infusion of the leaves of a certain shrub (tea), or of a decoction of certain roasted seeds (coffee). Some cause there must be, which would explain how the practice has become a necessary of life to whole nations. But it is surely still more remarkable, that the beneficial effects of both plants on the health must be ascribed to one and the same substance, the presence of which in two vegetables, belonging to different natural families, and the produce of different quarters of the globe, could hardly have presented itself to the boldest imagination. Yet recent researches have

shown, in such a manner as to exclude all doubt, that caffeine, the peculiar principle of coffee, and theine, that of tea, are, in all respects, identical.

"Without entering minutely into the medicinal action of caffeine (theine), it will surely appear a most striking fact, even if we were to deny its influence on the process of secretion, that this substance, with the addition of oxygen and the elements of water, can yield taurine, the nitrogenised compound peculiar to bile:

1 at. caffeine or theine .	=	C_8, N_2, H_5, O_2.
9 at. water . . .	=	H_9, O_9.
9 at. oxygen . .	=	O_9.
		C_8, N_2, H_{14}, O_{20}. =
= 2 at. taurine . . .	=	2 (C_4, N H_7, O_{10})."

After endeavouring to show, in the same way, that "The addition of the elements of water and of a certain quantity of oxygen to the elements of theobromine, the characteristic principle of the cacao bean (*Theobroma cacao*), yields the elements of taurine and urea, of taurine, carbonic acid, and ammonia, or of taurine and uric acid," he goes on to say: "To see how the action of caffeine, theobromine, &c., may be explained, we must call to mind that the chief constituent of the bile contains only 3·8 per cent. of nitrogen, of which only the half, or 1·9 per cent., belongs to the taurine.

"Bile contains, in its natural state, water and solid matter, in the proportion of 90 parts by weight of the former to 10 of the latter. If we suppose these 10 parts by weight of solid matter to

be choleic acid, with 3·87 per cent. of nitrogen, then 100 parts of fresh bile will contain 0·171 parts of nitrogen in the shape of taurine. Now this quantity is contained in 0·6 parts of caffeine; or $2\frac{8}{10}$ths grains of caffeine can give to an ounce of bile the nitrogen it contains in the form of taurine. If an infusion of tea contain no more than the $\frac{1}{10}$th of a grain of caffeine, still, if it contribute in point of fact to the formation of bile, the action, even of such a quantity, cannot be looked upon as a nullity. Neither can it be denied that in the case of an excess of non-azotised food, and a deficiency of motion, which is required to cause the change of matter in the tissues, and thus to yield the nitrogenised product which enters into the composition of the bile; that in such a condition, the health may be benefited by the use of compounds which are capable of supplying the place of the nitrogenised product produced in the healthy state of the body, and essential to the production of an important element of respiration."—(*Op. Citat.*)

This may be an ingenious attempt to adapt an atomic chemical theory to a physiological process, and nothing more; and yet it serves to mark the admitted importance of these great articles of modern consumption in the question of diet, and enables us to enter into the consideration of them with considerable advantage. The essential principles of these three vegetable substances being shown to be so much alike in chemical composition, and to be azotised to such a degree, their action on the system

might be, to some degree, inferred to be similar, and their stimulating and narcotic effects might likewise be to some extent rendered probable.

In speaking of the effects of any of these forms of the azotised vegetable principle on the system, those of the sugar, and of the warm or hot water, commonly mixed with them, must be taken into the account, or their possible influence be removed. The tendency of sugar to derange the digestive processes, by the difficulty with which it may be assimilable, should be borne in mind, and made to bear its due share of any derangement by which the use of any of these different beverages may be followed; and it need hardly be said, how often the dyspeptic finds the great use of discontinuing the consumption of sugar in his tea or coffee, and finds these beverages no longer causes of discomfort, but grateful auxiliaries to his digestive processes, when they had previously and invariably added much to his protœiform and complicated ailments. The effect of the hot liquid, in which these peculiar vegetable principles are commonly taken, likewise deserves to be separately and deliberately considered. Some several years ago, it became somehow the fashion for dyspeptics to drive off the fit of indigestion by copious draughts of hot water. In the course of months, relief was no longer afforded; the disease became worse; and in a few instances, terminated in very serious derangement of the digestive processes. In nearly all cases, the functions of the stomach were essentially enfeebled; rendering necessary to the common

comfort of the sufferer, and to the hope of his recovery, a protracted and exclusive use of the plainest and least irritating forms of food. The temperature at which these beverages are taken, is then an important matter, in the question of their utility and wholesomeness; and the more important, if the digestive organs are less strong, their functions more easily deranged, their tissues more easily irritated, and more readily enfeebled. Supposing that, when there is reason to suspect that the sugar produces dyspeptic symptoms, its use is discontinued,—and supposing that these beverages are never used very hot, and in some extreme cases are made use of only cold, or not far removed from cold,—their action is that of a stimulant and narcotic; acting like small doses of the stronger narcotics, in soothing the system generally, and the secreting tissues in particular; while the intellectual and perceptive faculties are stimulated and excited, in a degree that corresponds, other things being equal, to the dose of the agent.

The tea shrub, the *Thea* of botanists, is said to be peculiar to a tract of country on the eastern side of the Chinese empire, between the 30th and 33rd degree of north latitude. It appears that the plant requires much attention,—that it is raised from the seed,—that it is found to yield leaves of the required quality, only during certain years of its growth,—that the leaves are gathered at certain periods of the year,—that the gathering, rolling up, and drying, require to be performed with much care, and at the

expense of much time and labour. The leaves yield from 1 to 6 per cent. of theine, according to their quality. Besides the theine, the leaves contain 14 or 15 per cent. of casein,—and are therefore nutritious when eaten, as they are said to be by some oriental nations.

Besides theine and casein, tea-leaves contain a small proportion of astringent matter (gallic acid),—and, of course, a large proportion of inert and insoluble woody fibre. It is a curious fact, that when the leaves have been exhausted of all the matters capable of extraction by water, by repeated infusion, they yield nearly as large a proportion of matter to alcohol, from which it is readily given up again to boiling water,—the liquid tasting and smelling strongly of tea. The expense of the alcohol, and the trouble of again separating it from the aqueous infusion, prevent this from being more than a barren fact. Green tea usually contains more astringent matter than black tea, as well as more of the peculiar narcotic principle, on which the properties depend.

According to the interesting account given by Dr. F. J. F. Meyen in his "Outlines of the Geography of Plants," so ably translated and published for the Ray Society,* "The leaves of the tea-plant, when freshly plucked, have nothing of the odour

* Outlines of the Geography of Plants: with Particular Enquiries concerning the Native Country, the Culture, and the Uses, of the Principal Cultivated Plants on which the Prosperity of Nations is Based. By F. J. F. Meyen, Ph.D., M.D., late Extraordinary Professor of Botany in the University of Berlin, &c. Translated by Margaret Johnston.

and flavour of the dried leaves: they have neither a sharp, nor an aromatic, nor a bitter taste. The properties which they afterwards shew as prepared tea, and for which they are so highly prized, viz., the pleasant taste and delightful odour, are the effects of the roasting by which the leaves are dried. We need wonder the less at this, as it is the same with coffee. Every one knows that unroasted coffee possesses nothing of the pleasant aroma and ethereal odour, which are proper to it after being roasted. The tea-leaves are dried upon great iron plates, which are excessively heated, and in large flat iron pans, the sides of which are somewhat slanted. The leaves are first made to shrivel up in these pans by being constantly stirred with a gentle heat, and are then gradually dried by keeping up the heat. After this, the hot leaves are turned out upon mats, and rubbed with the palms of the hands; after having cooled, they are again put in the pans and again roasted, until the tea is perfectly dried, which is done by repeating this operation from four to six times." The leaves are said, by the same authority, to lose so much weight in this process, that "three pounds of fresh leaves produce only one pound of dry tea. The differences in the colour, shape, and pubescence of the dried tea-leaves, at first induced botanists to think that the green and black teas were prepared from different species; this, however, is not the case, but both kinds of tea can be made from the leaves of the same plant, as Abel learned during the journey of Lord Amherst. But when

once prepared, the tea, as Mr. Reeves also mentions, cannot well be changed; at least, black tea cannot be made into green tea, though the green may be changed, imperfectly at least, into black." In another place, Dr. Meyen says,—"The green tea is prepared in the manner I have already stated; the black, on the contrary, is made in what is called the moist way. The fresh leaves are laid on large sieves, and these are placed over boiling water, so that the leaves are fermented, and strongly infused by the hot steam. After this, the leaves are dried on iron frames, in the manner previously described." Such fermentation, and a consequent modification of the chemical constitution, in addition to a greater loss of the volatile constituents from their solubility in the steam, than would be sustained from exposure to dry heat alone, may serve to explain fully the different effects on the system of black and green tea.

Tea acts on the system as a stimulus or a sedative, according to the strength of the infusion that is taken. When taken in smaller quantity, its effect is, in general, simply, and in a small degree, sedative, even in the first instance; when used in larger quantity, its primary action is decidedly that of a stimulus. Its well-known effect of inducing wakefulness illustrates this. To many people, when taken late in the evening,—and in some, when taken strong, at almost any time,—it produces a very sensible degree of stimulation, and a state of sleepless excitability. Students and others, who devote to their pursuits the hours that Nature prescribes for

sleep, are well known to use and abuse this peculiar effect of tea. Besides inducing vigilium, tea seems to sharpen the mental faculties,—and perhaps, in an especial degree, that of the imagination:—

> "The Muse's friend, tea does our fancy aid;
> Repress those vapours which the head invade;
> And keep that palace of the soul serene."
>
> WALLER.

Green tea has, speaking generally, more stimulating; black tea, more sedative properties. The stimulating effects are, however, always and necessarily followed by sedative effects,—which may amount, in extreme cases, to depression, or even to a degree of narcotism; and, in most cases, it acts as a narcotic on the organs of excretion, producing more or less visceral torpidity and sluggishness. To the man who has a sufficiency of nourishing and wholesome food, the use of tea, in moderate quantities, and at proper times, cannot be said to be ever followed by unpleasant or unsatisfactory consequences. If taken in excessive quantities, tea becomes decidedly debilitating to the nervous system; affecting it in much the same way as any other stimulant and narcotic. But although tea, when used in moderation, is serviceable to the individual who takes a sufficient quantity of nutritious food, unquestionably serving some important purpose in completing and perfecting the last stages of digestion; and although, under such circumstances, the use of tea is not injurious; this is by no means the case when the aliment that is taken is deficient in

quantity, or of too poor a quality. Under such circumstances, tea acts on the nervous system to a degree, that is often productive of disorder, and which probably sometimes leads to disease. The extent to which tea is often made use of by the lower orders of people, under these very circumstances, is a frequent and important cause of ailment and injury. With many, it constitutes an invariable and important part of every meal, and does a proportional amount of harm,—enervating and deranging the digestive functions, and the general powers of the system. It were a vain task to try to induce such to forego the use of that, which seems to them to be necessary to keep them alive. Perhaps the best thing that can be done is, to induce them to mix the infusion with equal quantities of milk, which answers the double purpose of affording a considerable amount of nourishment, and of protecting the system, in some degree, from the deleterious influence of the tea.

Green tea, although said to be used almost exclusively in some countries, is found to be much too narcotic and stimulating for general and exclusive use in this country; and is necessarily forbidden to most invalids, from its evidently enervating effects.

The effect of tea on the second stage of digestion, and probably on the secretion of the bile, points out and explains its value, when taken about three or four hours after the principal meal of the day; and illustrates the well-known anxiety of the dyspeptic for tea-time, and the comparative comfort he enjoys

after this beverage, which is aptly said to cheer but not inebriate. Taken at the same time as a heavy meal of food, or such a meal as contains a large proportion of the day's alimentary supply, tea may prove to be too much of a diluent, or too directly narcotic; and, in some cases, may rather retard the primary digestion than otherwise. This, however, depends very much on the quantity and the strength of the infusion made use of.

Coffee, the seed of a by no means large tree,—the seed having a dense membranous envelope, and being inclosed in a berry,—is now an important produce of both hemispheres; although introduced into the West Indies little more than a century ago,—having been, perhaps, previous to that time, the exclusive growth of Arabia and of Persia, in which latter country it was probably indigenous. It is said to contain, besides caffeine, gum, bitter extract, gallic acid, and a large remainder of insoluble woody fibre. The berry, of a red colour, something like a cherry, and with a glutinous and insipid pulp, incloses two hard seeds; each of which has a flat side, to correspond with that of the other, and placed towards it. When roasted, coffee is found to undergo an important change in its composition; the most remarkable feature of which is, the formation or development of a fragrant and aromatic principle. Before this alteration, coffee seems to be improveable almost indefinitely by being kept: afterwards, it rapidly loses its properties, and cannot be used too soon.

Whether the roasted seeds be used in infusion or decoction, coffee is more nutritious than tea. It is, however, more difficult of digestion. Whether owing to the tannin, which the roasted coffee is said to contain, or to the aromatic oil, or the mucilage, or the bitter extract, or to the combination of these different constituents, coffee deranges considerably the stomachs of some people,—and is usually somewhat difficult of digestion to invalids, and to those who are more seriously dyspeptic. It is probable that this is not referable to the aromatic principle, as the best coffee, which contains more aroma, is less likely to disagree than the commoner sorts. The infusion is usually less apt to disagree than the decoction, unless the latter have been most carefully clarified; and then the extra cooking may more than compensate for the larger proportion of mucilage, &c., contained in the decoction. The consequence of coffee proving to be difficult of digestion, is rather to produce considerable acidity, and any derangement that may in time result from this, than to give rise to any other marked dyspeptic symptom. Supposing that coffee does not disagree, which in the healthy and strong it seldom does, it is a peculiar and decided stimulus, quickening the circulation, promoting the secretions and excretions, very perceptibly warming the system, and elevating the spirits. Its effect on the spirits is better known and appreciated among the Mahometans, and such people as are more or less strictly debarred, by their religion or their laws, from using the more direct alcoholic stimulants;

and is accordingly much used by them, with immediate view to its stimulating effects. Its peculiarly warming effects are, at least, equally important and valuable. These effects are remarkably durable. Dr. Rush was probably the first to notice this particularly. In his "Inquiry into the Effects of Ardent Spirits," he says that he once knew a country physician, who made a practice of drinking a pint of strong coffee previous to long-continued exposure to cold, and found it more cordial to him than spirits in any form. Perhaps, in some degree, on the same principle that alcohol, in its different forms, proves less directly stimulating, when taken along with a considerable quantity of nutrimentary matter, coffee may be more permanently stimulating in proportion to its nutritive qualities. However this may be, the warming effects of coffee are very considerable; and it is often most usefully taken either before or after continued exposure to cold, as in travelling. Without encroaching upon another and distinct department of this chapter, the practice—probably still a common one—of "taking a dram" of some kind of spirits before exposure to cold, may be adverted to. It is a practice that is at once foolish and dangerous. The stimulating effect of the spirits soon goes off, and is followed by a degree of languor proportioned to the amount of stimulation. This is the state in which the body is most easily chilled, and the secretion of the skin most easily checked,—in which an individual is most liable "to take cold;" and, if exposed to the depressing influence of cold under such

circumstances—after the stimulating effects have subsided,—the chances are very strongly in favour of the system suffering from it. Spirits ought not to be taken before such exposure; unless the person is to be so exposed only for a very short time, or unless the dose is to be repeated as often as the effects of the previous dose begin to subside. Coffee is little liable to this objection: its stimulating effects are much more lasting; and its warming effects seem to me to be even greater; and the subsequent languor is certainly less.

Supposing that the powers of the digestive organs are adequate to its complete assimilation, coffee, from being much more nutritious, and more decidedly restorative to the system, forms a better addition to other articles of food that are taken at breakfast, than tea. If its ready digestibility be suspected, the question of its being mixed with sugar, and the known difficulty with which sugar is digested, should be considered, before coffee is pronounced to be unsuited to the individual. The addition of milk to coffee adds much to its nutritiousness, diminishes in some degree its directly stimulating effects, and seldom makes its digestion more difficult.

There are probably few things for which we ought, as regards the means of health, to be more grateful to Providence, than for the introduction of tea and coffee. As civilisation advances, the man of wealth and rank uses personal exercise less, whether in walking or on horseback, and prefers the luxurious carriage as a means of transporting himself from

place to place;—keeping pace with the progress of civilisation, is the number of the thinking and the studious increased; a class of men, which is proverbially, and with few exceptions, sedentary;—tantamount to the increased number and importance of our commercial relations, is a larger number of men drawn from the fields, and the health-fraught toils of agriculture, into the pent-up and close atmosphere of a town, and have their time occupied in sedentary, or almost sedentary, employment; and in these ways, there has arisen a daily increasing number, of all classes, who, taking less exercise, could bear less food, could assimilate, consistently with health, a less amount of nutriment; who could not eat, with impunity, the meat and beer breakfasts, the heavy and substantial food, to which their fathers had been accustomed; and, as if to meet this, tea and coffee have been introduced, and supply the desideratum: a diet which is palatable, only moderately nutritious, and, if not abused, quite harmless. It has been the fashion, of late years, for the professors of certain new guises in which quackery has presented itself,—arrayed, in one case, in the assumed garb of facts and experience; in the other, in that of mystical and fanciful reasonings,—to contend against the harmlessness of these great beverages of daily use; and to advise their discontinuance, unless in occasional and probably infinitesimal doses, and for directly medicinal purposes. The experience, the comfort, the temperance, and the well-being of civilised man, are all happily adverse to such a view

as this; and, like most of the other errors of these quacks and visionaries, it hardly influences the many, and cannot long continue to influence even the few. The mild and grateful stimulus of these important beverages, probably ministering as they do, and in a large degree, to the digestion and health of the civilised and sedentary, is not to be given up at the bidding of those, who otherwise prove how small and bad their title to direct and control the public health, by the practice of either hydropathy, or homœopathy, or any similar mixture of reason and absurdity, truth and error, ignorance and fraud.

Cocoa,—the seeds or nuts of the *Theobroma cacao*, or chocolate tree,—is another of this important class of azotised vegetable substances. The composition of theobromine, the crystalline and azotised principle on which its qualities depend, has been already noticed, and is very similar to that of theine. The seeds grow in pods, some of which are said to contain as many as a hundred of the seeds. Cocoa is either used in the form of the ground seeds, simply made into a decoction; or these are ground into a paste, mixed with cloves, cinnamon, vanilla, and perhaps other aromatics, forming chocolate. Cocoa is oleaginous, and somewhat acrid; and is, in general, by no means so easily digested as either tea or coffee. But still there are many people, and it may even be said many dyspeptics, and many sedentary people, with whom it invariably agrees. The only thing that can be done under these circumstances, is to refer the question to the individual experience. The

decoction ought to be made weak, and, like coffee, to be taken at breakfast rather than in the evening. The marked taste of cocoa favours the use of it in the much diluted state of a very weak decoction, without discomfort to the palate; and so diluted, the decoction being made with water, and a larger or smaller quantity of milk being added at the time of using it, cocoa often proves useful as part of the breakfast, even of very delicate people. When made simply from the ground seeds, it is much more easily digested, than when prepared from pastes or powders, which are manufactured with various additions.

LIQUORS THE PRODUCTS OF FERMENTATION.

SPIRITS.

1. Brandy.
2. Hollands.
3. Whiskey.
4. Rum.

WINES—MALT LIQUORS.

1. Champagne.
2. Sherry.
3. Madeira.
4. Port.
5. Claret.
6. Hock.
7. Sweet Wines generally, including Home-made Wines.
8. Ale.
9. Porter.
10. Beer.

The effect on the economy, of all these various forms of fermented liquor, depends on the alcohol they contain; its influence being modified according to the quantity and the nature of the vegetable matters with which it is combined, and the degree in which it is diluted with water.

Alcohol is obtained by the fermentation of saccharine matter. The fermentation may be effected

spontaneously, that is, without the addition of any ferment to the saccharine liquor, when it already contains an azotised element capable of communicating the necessary movement to the saccharine atoms, which compels and permits their entering into the new mode of combination. This is the case in the great instance of grape-juice, which ferments spontaneously when at the temperature of from 40 to 85 degrees. On the other hand, the solution of pure sugar in water does not undergo fermentation without the addition of a ferment. In the case of grape-juice, the natural ferment is gluten, probably in some peculiar state, which fits it to undergo and produce the requisite molecular movement. Although the presence of an azotised substance is necessary to the spontaneous or the artificial fermentation of liquids containing sugar, this substance must be in the peculiar state, whatever that may be, which enables it to exert this remarkable property; for any putrid azotised substance may produce molecular movement in saccharine liquids,—such movement, however, terminating in ammoniacal degeneration, and not in the production of the alcoholic compounds.

Supposing that a liquid containing saccharine matter in solution, and containing, moreover, the necessary ferment, is exposed to the required temperature, an intestine movement ensues, the temperature of the liquor increases, and carbonic acid is evolved in large quantities; until, at length, the

movement, the disengagement of gaseous matter, and the turbidity, cease; the liquid becomes clear, and is found to be of less specific gravity, to have lost its sweetness, and to have acquired the alcoholic character, as to taste, smell, and stimulant action on the animal economy. To obtain alcohol from this liquor, the simple process of distillation is employed; by which the more volatile spirit is drawn off from the aqueous and other matters; being still, however, mixed with water, together with certain essential oils, &c.,—forming, in the case of distillation from wine, brandy,—in that from fermented sugar or molasses, rum,—in that from the fermentation of grain or of malt, whiskey, hollands, or gin, according to the various processes of the manufacture. From any of these, the purer alcohol may be obtained by a second or third distillation; the spirit, however, being still mixed with water, for which it has a remarkable affinity, and from which it can only be separated effectually by being distilled along with substances having a strong affinity for water, when an absolute alcohol is obtained in the receiver.

The sugar is, in the course of the great metamorphosis effected in the fermentation, converted into alcohol and carbonic acid. In the case of cane sugar, this is perhaps converted, in the first instance, into grape sugar, by being combined with a larger proportion of oxygen and hydrogen; this again yielding, from carbon 12, hydrogen 14, oxygen 14 (grape-sugar), 2 equivalents of alcohol, each equiva-

lent having the composition, carbon 4, hydrogen 6, oxygen 2; and 2 equivalents of water, oxygen 2, hydrogen 2: or this may be thus expressed:—

Grape Sugar—

Carbon . . .	12	=	2 Alcohol . .	8 C.	12 H.	4 Ox.
Hydrogen . .	14		4 Carbonic Acid	4 C.	—	8 Ox.
Oxygen . . .	14		2 Water . .		2 H.	2 Ox.
				12 C.	14 H.	14 Ox.

The probable action of alcohol on the economy of the system, is, by permeating the tissues rapidly, to come into very speedy and very general contact, by many and extensive surfaces, with the oxygen of the arterial blood, and to combine with it,—giving its carbon to the oxygen, forming carbonic acid,—its hydrogen to the oxygen, forming water; the effect being the disengagement of heat, independently of any alteration of the tissues, or of the conversion of arterial into venous blood by the union of oxygen with the carbon of the blood, upon which, under ordinary circumstances, the elevated temperature of the body is known to depend.* This effect is necessarily connected with increased action, excitement, and such stimulating effects on the nervous and vascular systems, as alcohol, however taken, is known to produce. According to this, the primary effect of alcohol is, to interfere with the combination of the carbon of the tissues and of the system generally, with the oxygen received by inspiration,—and by so much to diminish waste; the

* The first part of these remarks, on the effect of alcohol upon the system, is taken, almost verbatim, from the author's work on Gout.

secondary effect is, to excite the nervous and vascular systems; and the third effect must be such an amount of depression, as will correspond, other things being equal, with the amount of excitement that had preceded it. Such may be very fairly assumed to be the effects produced by alcohol upon the system; modified, however, by the form in which it is used, by its state of combination with other vegetable or nutrimentary matters; and much modified, likewise, by the degree to which the individual system may have been accustomed to its use. If the body has, from habit, acquired a custom of being supplied in this way with a certain amount of temperature and stimulus, without expense to the tissues, and without the use of the organs of motion,—if the heart and arteries have had their action correspondingly accelerated, and the respiration has been by so much quickened, the nervous system by so much excited, and the various functional processes, among the rest digestion, by so much facilitated in their performance,—the loss of all this must be largely felt; and it may hardly be withheld in many cases without decided injury, even although the obtaining these effects in an illegitimate manner, without exercise of the muscles, and without primary waste of the azotised tissues, may be virtually the cause of derangement in the amount or the regularity of the expenditure of the system, or increase materially the risk of disordered action. But there are undoubtedly cases, in which the use of alcohol, if moderate, and carefully adapted in quantity to the wants of the

system, may be beneficial: cases, probably, in which the supply of oxygen is excessive, or greater than the waste of the tissues is prepared to meet; in which, in fact, sufficient exercise cannot be taken to secure sufficient waste, nor sufficient non-azotised food digested to combine with the oxygen of respiration. If this should not prove to be the correct explanation of the fact, it nevertheless remains true, that there are cases in which some of the forms of alcohol may be used necessarily, and with much benefit. There are many cases, perhaps comprising a large proportion of the individuals in civilised life, in whom a certain moderate proportion of alcohol does no apparent harm, and, at least for the time, appears to do good. But these do not prove its necessity, and only serve to prove its harmlessness; and we probably want more extensive statistical and numerical proof, before we can say that "teetotalism," or even the using fermented liquors so irregularly as not to habituate the system to their effects, is, or is not, useful to the health of man; their excessive use being admitted, and only too well known, to be injurious.

When a habit of using alcohol in some form has been gradually, but decidedly, produced, it may soon become, in truth, part of the functional requirements of the system; and therefore to withhold it, may be to interfere considerably with those requirements, and by so much occasion derangement and loss of power. Such a step will be attended with more immediate and important consequences, the greater the

degree to which they have been used, and the more decidedly the alcohol may have been modified in its effects by its mode of combination. Thus, although a sudden discontinuance of a habit of drinking brandy-and-water daily, may be attended with great immediate depression, yet it is very doubtful if the eventual effect of this discontinuance upon the system and its powers, will be adequate, or nearly adequate, to that of as suddenly leaving off the use of malt liquor or wine. There is another consideration, of little less importance. In the use of malt liquor and of wine,—however much the alcohol contained in them, probably in a state of very intimate combination, may promote the digestion of the nutrimentary constituents,—yet the assimilating organs must be called upon for the conversion of those constituents into the materials of the body; making the question of their use very frequently one of much doubt,—and, in many stomach cases, leading us temporarily to substitute alcohol in a purer form, when it might not be advisable to discontinue the use of this powerful stimulus. To leave off the use of wine, when the system has been long accustomed to its daily influence, is often a very unwise proceeding. If there are sufficient reasons, which will probably seldom be the case, for leaving off the use of everything containing alcohol, the experiment should be made slowly and gradually, under such circumstances. The blood, the tissues, the nervous system, the general powers and functions, cannot be suddenly or greatly deprived of so energetic and rapidly acting an agent, if long accustomed to

its influence, without risk of loss of strength and derangement of function; and I believe this risk to be greater, the larger the proportion of nutrimentary matters that is combined with the alcohol; and, consequently, to be greater when malt liquor has been so made use of, than when the alcohol has been used in the form of wine,—and consequently greater in the case of heavy fruity wines, than in those of a thinner quality.

It must not be at all inferred from what has been said, that it is intended to recommend the habitual use of spirits, in preference to that of malt liquor or wine. On the contrary, the use of alcohol, only qualified with water, or very slight vegetable additions, as may be the case in brandy, whiskey, rum, and hollands, is probably directly injurious in the same proportion as it is so uncombined, and therefore so unmodified in its stimulating effects; this being compensated only by the lessened difficulty of assimilation, and the less consequent risk of disturbing the digestive process; and therefore it can be only when habit, or the circumstances of the case, render an alcoholic stimulus necessary, and yet the state of the digestive organs renders the assimilation of wine or malt liquor difficult, slow, or imperfect, that spirit, or spirit-and-water, should be taken. In such cases, the purer and older the spirit, the better; and the more largely the stomach will permit it to be diluted with water without being inconvenienced by it, the less will it be likely to do harm; and it will generally be better that it should be mixed with cold

water than warm,—and, in cases of stomach irritation or marked dyspepsia, without sugar than with it.

In the tabular list of the different products of alcoholic fermentation chiefly made use of, the individual articles are classed in the order in which I believe them to be usually digestible.* Or the wines may be thus classed, according to their four principal varieties.

1. Old wines which have lost their sweetness, and much of their fruitiness, without acquiring acidity.
2. Fruity Wines.
3. Sweet Wines.
4. Acid Wines.

Liquors, the products of fermentation, may be said to be more easily digested, in proportion to the larger

* It is perhaps only fair to say once again—no such rule can be without exceptions. Idiosyncrasy, or peculiarity of constitution and habit, forms many cases to which no such universal rule could be applicable. One man is found to be nauseated by even the smell of nuts; another man is immediately covered with nettle-rash after eating anything which contains oatmeal; another has his tongue furred, and his digestive organs disturbed, by the slightest odour of onions; and another is so strongly sensitive to the action of certain perfumes, that a slight odour of musk will bring on faintness, or a bouquet of flowers in his room induce dyspnœa. It is not, of course, such cases, nor cases resembling them, that such tables are meant to include. It is well known that one man cannot drink any kind of spirit without suffering afterwards from its effects, while he can take his bottle of wine at a sitting without inconvenience. It is well known that some men cannot drink sherry, but can drink port without inconvenience; and that others cannot drink port, but can drink sherry. It is not the question whether brandy always agrees better than wine; but it is simply, whether brandy does not generally occasion less inconvenience to the stomach, and especially to the dyspeptic stomach, than wine does. The question is, whether sherry is not generally better borne, and more easily digested, than port. And such question will admit of only one answer, which will correspond to the opinions advanced in these tables.

quantity of spirits, and the smaller quantity of other matters, which they contain; in fact, in proportion as they are *stronger* and *thinner*,—destitute alike of sweetness and acidity. But, in the large number of cases, the selection of the alcoholic liquor to be habitually made use of, should not be made a mere stomach question; although in dyspeptic cases, and invalid cases, it must usually be simply so looked upon.

Brandy is decidedly the best form of alcoholic stimulus for the weak or disordered stomach, provided it is prevented from unduly irritating that organ, by being sufficiently diluted with water. A reference to its chemical composition does not show why brandy is preferable to, and more wholesome than, the other kinds of spirit. It is very probably a simple question, as to the greater age and purity of the spirit. It is quite true, that the older the spirit, the more wholesome and digestible, and the less irritating, it is found to be. This is quite independent of the proportion of alcohol contained in the spirit, which may be stronger or weaker than the newer spirit, with which it is compared. The extreme acrimony, and injurious effects on the system, of new rum, are well known to publicans and dram-drinkers; and although this does not probably obtain to the same extent in the instances of the other spirits, it nevertheless does so in a considerable degree. Gin, or hollands, is prepared from a fermented infusion of malted barley and rye, and is flavoured with the oil of the juniper berry. It is

therefore more diuretic than the other spirits, and may, on that account, be preferred to them in some cases. Whiskey, prepared from malt mixed with unmalted grain, is likewise peculiarly diuretic in its effects on the economy, although by no means so much so as hollands. Rum, prepared from sugar, or from molasses, is more sudorific in its effects than the other spirits, and is more immediately stimulating and heating to the system. It is, by common consent, the least wholesome of the spirits, and the most apt to derange the digestive organs, and interfere seriously with the functions of the liver.

Of the wines, champagne is usually considered to be the most easily digested. This is due to the fixed air that it contains, for sillery is not so easily digested as the effervescent wine. The digestibility and wholesomeness of champagne is, however, a reasonable matter of much doubt. It is an imperfectly fermented form of wine, of which the free carbonic acid is a product and a proof. However easily it may be digested in the first instance by the stomach, its ultimate assimilation is often difficult.

Sherry, when sufficiently old, and pure,—free from admixture with inferior wines, and free from acid,—is the most valuable form of wine for the use of the invalided. A perfect result of fermentation, free from acid and from sweetness, with much aroma, matured into a perfect combination by age, sherry becomes one of the most easily digested and readily assimilated forms of alcoholic stimulant. It has a very slight degree of astringency, which may be

owing to the skins in which it is conveyed from the interior to the coast.

Madeira is only inferior to sherry, as regards its digestibility and wholesomeness, from usually containing some proportion of free acid. It might otherwise, when fully matured, and of the finest growths of the island it comes from, be considered to be the best and soundest wine imported into this country. It is generally sufficiently digestible, and is remarkably restorative; and where its highly stimulating qualities, and the degree of free acid it contains, are not objectionable, it may be wisely preferred to any other wine for the use of the feeble or the convalescent.

Port wine is peculiarly characterised by containing a considerable proportion of astringent matter. This is apt to derange the primary processes of digestion, —and probably still more, the ultimate processes of assimilation; and the astringent wines should be made use of habitually, with a corresponding degree of caution, and watchfulness as to their effects.

All the above wines commonly contain a large proportion of added and less perfectly combined alcohol, said to be added to suit the British market and British palate. Brandied wines are necessarily less wholesome than the pure wines.

The French wines—the clarets—contain less alcohol than those of Spain, and have usually less brandy added to them afterwards. Professor Brande, in his admirable and elaborate tables, states the average proportion of alcohol, specific gravity ·825

at 60°, by measure, to be—in port wine, within a small fraction of 23 per cent., in Madeira 22·27 per cent., in sherry 19·17 per cent.; whereas in claret the average per centage was found to be 15·10, in hock 12·08, in champagne 12·61, in gooseberry wine 11·84, in cider 9·87, in ale 6·87, in porter 4·20, and in brandy 53·39. Consequently, port wine may be considered to be somewhat stronger than sherry or Madeira, nearly twice as strong as claret, more than double the strength of hock, four times as strong as ale, and half as strongly alcoholic as brandy itself. It is not, however, to be inferred, that any quantity of combined alcohol, which may be contained in any wine, will have the same effect on the system, as the same quantity of uncombined spirit mixed with water. Half a bottle of brandy would certainly have more intoxicating effect on the system than a bottle of port wine. But it may be fairly inferred, that the combined spirit in one kind of wine, will have the same proportional effect on the system, as the combined spirit in another kind of wine; and, consequently, that the French and German wines are much less stimulating, and so far less heating, and less injurious, than the Spanish wines.

Clarets are, then, a weaker form of alcoholic stimulant, and contain usually less uncombined brandy, and are by so much purer forms of wine. They all, however, contain much free acid, which renders their use objectionable in most dyspeptic cases,—embracing under this head, the cases generally of disordered assimilation. The finer qualities of claret are, how-

ever, much less acid than the inferior sorts; they have, moreover, more aroma; and are, on both these accounts, much more wholesome. There can be no question, that, in a large proportion of wine-drinkers, the amount of acid contained in these wines, and especially in the finer qualities of claret, is no ground of objection to their use; nor that, from being purer and less stimulating wines, and from containing a much smaller proportion of free spirit, they must, when the acid is not injurious, be much more wholesome and useful to the economy.

The quantity of nourishment obtainable from wine and malt-liquor, is a curious, intricate, and interesting subject of inquiry. There can be no doubt, that the amount of nutriment these several liquids afford to the economy, bears no necessary proportion to the per centage of alcohol they contain; nor even, as far as we can judge, to that of the saccharine, azotised, or carbonaceous ingredients, that are contained in them. Whether or not this may be explicable, on the principle of the nutrimentary and the stimulating matters being so essentially combined, that they are taken more readily into the system, and with less expense to the assimilating organs, than other forms of nutrimentary matter,—there can be no dispute, that malt-liquor and wine do afford an amount of nutriment to the system, that is greater than a knowledge of their composition could have led us to infer. But, this having been granted, it must, at the same time, be allowed, that the chief use of all or any of the products of fermentation is, to rouse the circulation

into more energetic action,—to increase the activity of the absorbents, and enable, and indeed compel them to do more work, to take up more nourishment from the food,—to force vessels, debilitated from whatever cause, or depressed by whatever influence, to pour forth more of those secretions, which are necessary for the conversion of food into chyme,—to urge those vessels to increased exertions, which absorb the chyle from the chymous mass, and convey it to the current of the circulation,—to stimulate the heart's action, and cause the blood to flow more quickly through the vessels, carrying with it at once the new material to be deposited in every tissue and every fibre, and the stimulus to *enforce* its conversion into texture. And this may be the chief use of alcoholic stimulants in the economy, in whatever form they may be exhibited.

Hock, and the German or Rhine wines generally, contain more acid than the clarets, and less alcohol. They are light, and remarkably free from mucilaginous matters; and, when the acid is not objectionable, are sufficiently wholesome and useful. As in the case of the clarets, the finer qualities are much more wholesome than the inferior kinds. The degree of aroma contained in wine, materially increases its digestibility and wholesomeness.

The sweet wines, when the sweetness is in absolute combination with the other ingredients, are usually sufficiently wholesome and easily digested. Such wines are malmsey, constantia, &c. Even these, however, are by no means suitable to the

dyspeptic stomach. When the sweetness is not in such perfect combination in the wine, but is merely mixed with and added to the other ingredients, as is the case in home-made or British wines, the question of digestibility is much more doubtful. Such wines should not be made use of by invalids or dyspeptics.

The digestibility and wholesomeness of malt liquors, is much influenced and modified by the amount of mucilage, free saccharine matter, and bitter principle, they contain. The less mucilaginous, the less sweet, and the more bitter, ale is, the more digestible and wholesome it may be usually considered to be. Ale should be pale, perfectly clear, sufficiently old to have its fermentation fully completed, and not old enough to have become in any degree acid. Such ale is, perhaps, generally more wholesome than porter,—however good in quality the latter may be. The stronger kinds of porter are, however, much more nutritious than ale; and in cases of debility, and in some diseases—diabetes, to wit—may be indicated strongly, for this reason. In the cases of the dyspeptic, the valetudinarian, and the sedentary, the habitual use of malt liquor, of any kind, ought, however, to be looked upon with much distrust and suspicion, as of probably injurious tendency.

It should be borne in mind, that whereas in the invalided or the dyspeptic, where the use of the alcoholic stimulants is indicated, according to the degree of the dyspepsia should the form in which the alcohol is exhibited be more and more pure; the extremely dyspeptic being ordered brandy and water; the less dyspeptic, the stronger wines; and those

still less dyspeptic, the weaker wines; while those only who have no marked stomach derangement should make use of the malt liquors; so, on the other hand, in the case of the healthy and the active, the more diluted the form in which they make use of the alcoholic compounds, and the more largely they are combined with nutrimentary matters, the less likely they are to prove injurious to the economy. If the drinking some kind of alcoholic stimulant is to be habitually indulged in, there can be no doubt that the ale and porter drinker runs least risk, the wine drinker more, and the spirit drinker most. This fact is easily and well illustrated by another, which is well known and universally admitted,—that so long as a man has a healthy appetite for food, and can take an average quantity of it, stimulants are less hurtful to him; and it is when he loses his appetite, and can eat very little food, that they injure him most. Now, ale and porter contain a considerable proportion of mucilaginous, glutinous, saccharine, bitter, and other matters, in combination with the spirit, by which the irritating and deleterious effects of the alcohol must be, in some degree, counteracted. In this respect, a good deal of stress may be fairly laid on the bitter principle that ale and porter contain,—soothing and allaying the irritation that might be produced by the spirit; while the gluten and the other ingredients, nourish and give tone to the system. The effect of the bitter principle in modifying that of the spirit in the case of malt liquor, is well illustrated by the well-known influence of the vegetable bitters, in the case of the languid and expended

debauchee, in relieving, soothing, and giving tone to his expended digestive organs. Whereas ale or porter, then, from their containing so large a quantity of other matters mixed with the spirit, necessarily task more the digestive powers than wine or brandy, and are therefore justly said to be less suited to the stomach that is feeble or dyspeptic; such combination and dilution of the alcohol with nutrimentary matters, makes them more suitable to, and less likely to injure, the healthy and the active. To be able to use malt liquors habitually without injury to the system, involves the necessity of a larger amount of exercise than is necessary for the maintenance of health under the habitual use of wine, on the simple principle of their being so much more nutritious,—and more nutritious, as I believe, than their composition would lead us to infer. The degree of exercise must, of course, depend on the quantity of malt liquor made use of, and other circumstances. There are men engaged in certain employments in London, who have long been noticed and quoted, on account of the large quantity of malt liquor habitually consumed by them. These are principally the men employed on the river Thames, in loading vessels with ballast,—those engaged in emptying the coal barges,—and the brewers' draymen. It is said that many of these men drink several quarts of malt liquor every day.* They are

* "Each man (of the ballasters) drinks from two to three gallons of porter daily, and generally a considerable quantity of spirit besides." —Dr. William Budd.

large, gross, and unwieldy men,—capable and called upon to undergo a great deal of bodily labour; and they work, for the most part, in the open air. To estimate, however, fairly and fully, the effects of this great abuse, even of this much modified form of alcoholic stimulus, such men's lives should be watched, until the effect of a common inflammatory attack, or a severe bruise, or a lacerated wound, or a fractured bone, may be seen. And then it is found that these men, apparently so strong and full of vigour, will not bear the depletion that their ailment indicates; that they must be treated with opium rather than the lancet; that they cannot be kept to the antiphlogistic regimen; that their disorders run into incurable disease, with fearful rapidity; and their injuries are often converted from simple cases, that in healthy systems might hardly require any treatment at all, into serious and fatal ones. The full habit of body, the florid and swollen face, the corpulent abdomen, and fat extremities, are not indications of sound health and an unimpaired constitution. That man only is in good health, who recovers rapidly from the simple accidents incidental to his occupation, and from the simple disorders incidental to his humanity and to the climate he lives in, and who can bear the treatment that those accidents or those disorders demand; and such a man is not he who uses in excess alcohol in any of its forms; but, far more probably, the man who is, from hereditary or acquired strength of constitution, able to maintain himself in health and strength, without

making use of alcohol at all, or who makes use of no more than just suffices for these purposes.

The ultimate effect of alcohol on the organs, and on the condition of the body generally, when it is used habitually, differs, in some degree, according to the form in which it is used. The larger the amount of nutrimentary matter with which the alcohol is combined, the more gross does the system become, and proportionally the more lethargic. This is, of course, most observable, when malt-liquor is largely made use of. It is much less marked in the case of the wine-drinker; and so much less so in that of the spirit-drinker, that the latter is rather characterised by a sunken face, and thin extremities, than the swollen features and thick limbs of the malt-liquor drinker. Still, however taken, the effect of alcohol is, necessarily, to charge the system with carbon,—to overwork the liver and the kidneys,—to produce accumulations of fat, particularly in the cellular tissue covering the abdominal parietes, and in that of the omentum,—to produce engorgement, congestion, and eventually disease of the liver, and, especially in the case of the spirit-drinker, eventually likewise of the kidneys,—to derange generally the functions and organs of the body, and predispose the latter to take on any morbid action to which they may have been hereditarily predisposed, or to suffer from any of the exciting causes of disease, to the influence of which the system may be subjected. Thus, the intemperate abuser of the alcoholic compounds, not only subjects his system to alternations of excitement

and consequent depression,—at one time, stimulating the nervous system,—then, throwing it into a state of lethargic torpor,—and then, subjecting it to much exhaustion and depression; not only does he entail upon himself the saddest moral consequences,—lowering the tone and character of his highest faculties, and circumscribing and enervating his intellectual capabilities; not only does he interfere with his digestive powers, and the regular and due assimilation of the ingesta, and the adequate expenditure of the effete matters of the system; but, eventually, he entails so much derangement of the general economy of the system, and so seriously interferes with the functions of certain of the organs, and so deranges the character even of the blood itself, and so adds to the organic sensitiveness of the tissues, that, if not cut short in the wretched career by some common casualty, such as an accident or an inflammation, which, in this depraved habit of system, may lead to disorganisation and death, his life must be shortened by the gradual establishment of structural changes in some of the great organs of the body,—and the end is known to be, in most such cases, much more wretched than the deaths of the temperate.*

* The effect of spirits in adding to the accumulation of fat in the system, was forcibly illustrated some time ago, in the case of a very young man, who died thus early from the intemperate use of spirits. It appeared, that, for several months, he had been unable to eat more than a very small quantity of food, and that his powers were almost exclusively maintained by frequent dram-drinking. The immediate cause of death was cerebral ramolissement; but, although the body

It is a practical and important deduction from what has been advanced, that, admitting the usefulness of the alcoholic compounds in many constitutions, when temperately used, they should never be needlessly made use of, and never to an intemperate degree. It is quite true, moreover, that children, and young people generally, are more likely to grow up into healthy men and women without alcoholic stimulants in any form being used by them habitually; to which, however, some cases of scrofulous or feeble children may be necessarily and properly excepted.

The circumstances under which the alcoholic compounds are taken, modify their effects to an important degree. They should be mixed as much as possible with the alimentary supplies; and, therefore, are most safely as well as usefully taken with the mid-day meal, which should be the most substantial meal of the day, comprising a fair proportion of animal food. To meet this intention, the malt-liquor, the wine, or the spirit-and-water, should be taken in divided portions, at the same time as the solid food,—and thus mixed with it as much as possible. If taken before, or even after, the meal, the alcohol is apt to be immediately absorbed from the stomach into the system; thus acting more

was much attenuated, the muscular fibre of the system much wasted, and the subcutaneous fat of the extremities had almost disappeared, on cutting through the abdominal walls to examine the condition of the liver, a very considerable thickness of fat had to be divided; the more remarkable from the general attenuation, but probably not less than three times as thick as is usually met with.

directly as a stimulant, and aiding less in the digestion of the aliment, and promoting less the nutrition of the body. It is almost always unwise, under any circumstances, to allow any of the forms of alcohol to be made use of habitually in the evening, or within a short time of the hours of sleep. The system is generally more excitable in the evening, and the effect of alcohol by so much the greater. But the effect of a stimulant in the evening, is to render the sleep less perfect and less refreshing,—to disturb more decidedly the economy of the nervous system,—and to risk much more than when the stimulant is taken in the middle of the day, the eventual interference with the action of the secreting organs, and the production of visceral sluggishness, and consequent congestion. It is almost too well known to make it necessary to add, that none of the alcoholic compounds should be taken into the fasting stomach,—involving, as this does, their immediate and unqualified absorption into the circulation, and their most decided action as mere stimulants to the economy.

If a man will use habitually any of the alcoholic stimulants, he ought to take care, that, as far as he can, he uses a degree of exercise proportionate to the quantity he indulges in. It may be relied on, however, that, when the system is not peculiarly feeble, from hereditary infirmity or predisposition, or from a defective early physical education, or from other causes, the full maintenance of health and strength seldom requires the habitual use of any liquid, which

is a stronger stimulant than water. Medical men have generally to contend with the consequences of long continued habits, which may fairly be called habits of excess, and which it may be unwise, or even unsafe, to interfere with, or even to modify in any very considerable degree.

It is a curious and interesting fact, that, in districts far removed from one another in geographical position, having, perhaps, however, some climatorial characteristics in common, and in which the inhabitants in some degree seem to stand in need of some means of checking the disintegration of the tissues of the body, plants have been provided, which exert this influence on the system, and appear to be made use of advantageously, although, of course, without any direct idea of the effect produced thereby. Thus the Peruvian makes use of the leaves of the coca plant, the East Indian and South-Sea-Islander of the areca or betel nut, the Turk of opium, and the Chinese and American of tobacco. But, however properly, or even needfully, these several narcotics, with the exception of opium, which must be always too powerful for habitual use—may be had recourse to, under certain circumstances of climate and habits of life, they cannot be required, and may by so much do harm, when men are placed under very different external circumstances, when the expenditure of the system may and indeed must be justifiably great, and when the alimentary supplies are at least equal to the possible expenditure. It is neither surprising, nor difficult of explanation, that the habitual use of any

of these narcotics, under such circumstances, should interfere unduly with the expenditure of the system, should enervate and derange the nervous system, should diminish the action of the great emulging organs, should eventually induce visceral congestion, should charge the system with carbonaceous matters, and in the end disturb and impair the assimilating functions. And such is the fair statement of the effects of tobacco on the system in these latitudes, and what may be gathered to be the effects of this and similar substances, when used in excess, in the countries where their moderate use appears to be required. There is in Dr. Meyen's work, already quoted from, an interesting illustration of the effect of climate in modifying the ultimate effects of the coca leaf on the system, which may be fully extended to tobacco and the other narcotics when used habitually. The extract is, moreover, otherwise interesting :—

"Poeppig, who, during his stay at Huallaga, on the eastern side of the Peruvian Cordilleras, was for several months in parts where the coca is grown, has given us full information concerning this branch of Peruvian agriculture. Just as it is extremely difficult for a drunkard or a real tobacco smoker to give up his favourite indulgence, so it is difficult for a coquero to refrain from the use of the coca. We also learn from these travels, that the use of coca is as universal on the eastern side of the Cordilleras of Northern Peru, as on the table land in the south, and the consequences of it are said to be very bad in the warmer and damp districts. In the cold

and elevated parts of the plateau of Chuquito, where the use of coca is certainly very general, and that not only amongst the Indians, but amongst the mixed races, as well as the whites, little is to be observed of all the dreadful diseases which are said to arise from its use. In the villages and towns around the basin of Chuquito, Indians, negroes, whites, and persons of mixed blood, of extreme age, are seen going about, and now as before using the coca. The women of these parts, who, as of mixed blood, are known under the name of Zambitas, are exceedingly corpulent, and chew coca as generally as betel is used in India, without exhibiting any signs of the dreadful consequences. By the mixture of burnt lime, which is much more general in Northern Peru than in the South, the teeth are dyed in a disgusting manner, but they do not suffer any injury, which can easily be seen to be the case on the islands of India, where the betel, mixed with lime, is one of the ordinary enjoyments of life. It is certainly the case, that the excessive use of coca, on account of its volatile principle, which produces an effect similar to that of opium, weakens the organs of digestion and gradually over-excites the nervous system; and a number of diseases thus arise, which, however, are far from being so dangerous as those which are the consequence of using opium."

The Peruvians chew the coca leaves either by themselves, or mixed with clay or lime, and made into little balls, which they keep in the mouth until they find all the bitter and strong taste to have been

extracted. The betel is formed from the nut of the areca palm, rolled in leaves of the betel pepper, striped with moistened chalk on one side. The use of this, which is said to turn the teeth to a red colour, to stain even the gums, and produce a constant flow of saliva, and to be altogether one of the most disgusting practices imaginable, prevails extensively, and almost universally, among the native East Indians, the South-Sea-Islanders, &c. Of the extensive use of opium among the Turks, and more recently among the Chinese, it is hardly needful to speak. The most powerful of the narcotics,—when used habitually, it becomes a stimulus of great activity, and of proportionably great injury to the nervous system,—lowering the tone and disturbing the equilibrium of the circulation,—enfeebling and deranging the several processes of secretion and excretion,—and leaving the wretched consumer of this potent drug, the victim of depression, and of ills of all phases, mental and bodily, in the intervals between his paroxysms of blissful excitement,—and eventually the victim of a premature imbecility of mind, with an organism worn out before its time, and the scarcely-to-be-pitied prey of an early death. "The Confessions of an English Opium-Eater" leave nothing to be wished for, in the description of the frightful effects of the habitual use of opium.

Tobacco plays a more important part in this country, as to the habits of the people. However used, whether smoked, chewed, or used as snuff, its action on the system is but little different. It is essentially

a narcotic; and as such, it is detrimental to the power and healthiness of the nervous system,—as such, it stimulates at the expense of subsequent depression and eventual loss of tone,—as such, it interferes with the functions of assimilation and expenditure,—and as such is injurious to the health of the system. Tobacco exerts more marked and injurious effects when chewed, less of these when smoked, and is least deleterious when used in the form of snuff. This is only, however, a question of degree; and in the temperate climates, the use of tobacco in any way can only be justifiable, when, from poverty of diet, and consequent vital depression, the effects of an habitually used narcotic may not be undesirable.

Perhaps enough has been already incidentally said as to the effect of water when taken into the system, so far as its action as a chemical agent may be of importance, by furnishing oxygen and hydrogen to the organic processes, and entering into combination accordingly with the materials of the body; or at all events, this may have been sufficiently noticed, so far as it seems to be a necessary supposition in explaining some of the organic processes;—the digestion of water and other liquid food by immediate absorption from the stomach, has, moreover, been already referred to;—and the importance of water, as a solvent for the more solid ingesta, and the menstruum of all the alimentary supplies,—as the great softener and fashioner of the organic atoms,—as furnishing the stream, by which the new atoms are conveyed to

the different tissues and structures, and by which the effete matters are removed, and by which the oxygen of the respired air is conveyed and consumed equally in all parts of the body for the maintenance of the animal heat, is, moreover, great and interesting. But the effect of the aggregate quantity of water taken into the system, and of the periods at which it is taken, on the stomach, and on the general functions and powers of the body, are of more direct practical importance to the present inquiry.

The stomach may be too weak, and the system generally too feeble, to bear large draughts of water at a time, without inconvenience; and its absorption may be consequently so difficult, slow, and imperfect, as to render the use of it very properly a subject of caution and guidance. This may be remediable by restricting the quantity made use of; or it may be necessary to combine it with demulcents, or with aromatics, or with stimulants, to obviate the inconvenience. When taken shortly before a meal, in debilitated states of system, or feeble conditions of the digestive organs, water may remain long unabsorbed, or so expend the energies of the organ to effect its absorption, as to diminish very much the chance of the food next taken being digested without inconvenience. When taken in too large quantity along with the food, it may unduly task the powers of the system to effect its absorption, and thus very much retard, and probably derange, the digestive process. Taken soon after a meal, when the stomach

is engaged in the primary digestion, and the food and gastric juice are being blended, and are in a state of re-action, the effect of water, even in the strong, and when the function of the stomach is in a state of healthy activity, is, commonly, to interfere much with the digestion, interrupt the solution of the food, and give rise to dyspeptic symptoms. When the stomach, or the system generally, is in a languid or disordered state, these facts ought to be especially remembered; and the quantity of water taken, should be carefully regulated by the wants of the system; and the time at which it is taken, in reference to the meal-times, should be likewise attended to,—limiting the quantity taken soon before a meal, or at the same time with the food, or shortly after it, as much as possible,—and letting it be taken, as much as may be, neither soon before nor shortly after the meals, and even then in regulated quantities.

As to the ultimate action of water on the system,—its effect as a solvent for the effete matters, and a direct means of their elimination,—the influence of the great solvent may be made useful in many disordered conditions of the body; and, on the other hand, may be carried much too far, and with injurious consequences to the system. It seems to be a simple enough fact, that, however pure may be the state in which water is taken into the system, it is never pure when discharged from it; but always carries off, in solution, saline and azotised matters; and is, to the same degree, an emulging and expending agent. This may be most useful in maintaining health, in

warding off disease, or in correcting or removing morbid action. It may promote needful secretion; it may carry off redundant matters; it may relieve local irritation; it may equalise the general circulation, or remove the slighter degrees of congestion; and act beneficially upon the plethoric, the sluggish, or the excited, conditions of the system, which may or may not be sufficient in degree to amount to disease. The good effects of water, as a diluent and emulgent, in the human body, whether in health or disease, can hardly be exaggerated in importance. But, in the same degree, it is possible to make too much use of so energetic an agent;—to the same degree, it is possible to make it a means of inducing debility, whether local or general; and an unwise means of expending the powers of the system. Water is by no means a weak and unimportant agent in the animal economy; and is as capable as most other powerful agents, of subserving the well-being, or of deranging the tone and healthiness, of the system. It has been, of late years,—thanks to an extension of one of the forms of modern quackery to the habits of the people!—too much the custom to drink water more largely than the system requires its diluent and emulgent action, in the delusive hope of its acting, in some mysterious way, as a tonic and remedial agent. However taken, when used in larger quantity than the wants of the system imperatively require, water must always act as an emulgent, and, to the same extent, as an expending and debilitating agent, —and should by so much be made use of cautiously

in any excessive degree; and only according to the evident requirements of the system, whether it be healthy or diseased; and with a view to, and due consideration of, its emulgent effects.

The individual articles of diet have now been discussed. A number of general observations have been interspersed among them. Some, however, still remain to be mentioned.

Eating at regular hours, is one of the most important dietetic regulations. It is one, which the man who is in a state of comparative health might do well to attend to; and one, the necessity of which cannot be too strongly impressed upon the invalid. The interval of time between the meals ought not to be longer than *five*,—nor less, as a general rule, than *four* hours. For instance, if the first meal is taken at eight o'clock in the morning, the second might be advisedly taken at one P. M., the third at five P. M., the fourth, if a fourth were found to be necessary, between eight and nine o'clock in the evening. It may be observed, that, according to this, five hours is allowed as the interval between the first and the second meal; four hours after the second meal; and only three hours and a half after the third. The reason is, that the two former should be the principal meals; and ought to be looked upon as being virtually the only *meals*. The third meal usually consists essentially of tea, which acts as a cordial and restorative to the stomach, and is generally very grateful; and, in some cases, when the stomach is either languid, or morbidly sensitive,

may be very useful, and even be necessary. The advantage of taking a certain quantity of liquid three or four hours after a meal which substantially consists of solid food, and the digestion of which expends or employs so much of the fluids of the system, is sufficiently apparent,—and is usually indicated by the sensations; and when the peculiar azotised principle contained in tea, is added to the mere diluent action of the water, subserving a sedative or narcotic purpose on the tissues and the nervous system generally, and probably some secondary good effect on the secretion of bile, the usefulness of the third meal of tea needs neither further illustration nor further defence. If very little or no solid food is taken along with it, tea does not add in any apparent degree to the labours of the stomach, but rather and simply aids it in the completion of the digestion of the previous meal. And, indeed, so fully am I persuaded that it is in this way the third meal should be regarded, that I should advise the great majority of people to eat nothing at tea-time. So taken, about three or four hours after what is almost always the heaviest meal in the day, tea is simply and decidedly soothing and restorative; facilitating the assimilation of any still undigested matters that may remain in the stomach, and leaving so long an interval between the dinner and the supper, or the dinner and the bed-time, as may commonly enable even the feeblest stomach to dispose of the largest meal of the day. But if any solid food is taken with the tea, the stomach, hardly recovered from the

expending consequences of digesting the dinner, is again set to work; and the beneficial effects of the tea are apt to be counteracted by the call on the stomach for a renewal of its labours. The student will, I think, commonly find that, after a cup of tea, thus taken by itself, about three or four hours after his dinner, he will be better prepared for any intellectual exertion, than at any other time of the day; whereas, if he takes solid food with the tea, mind and body are apt to become more or less lethargic; and he loses, to a greater or less extent, his command over the mental faculties, for an hour or more. If the practice of eating nothing at tea-time, need not be regularly adhered to,—when a reason or necessity for an extra degree of mental labour exists, it may be usefully adopted.

The breakfast should always be an important, if not the most important, meal of the day. It should seldom be taken until some little time after rising in the morning, and seldom until after some little exercise has been taken. The necessity for this rule is greater, if food have been taken late on the preceding evening, and the possibility of any remaining crudity of stomach from the preceding meal is involved. In many cases of debility, whether of the digestive organs in particular, or of the system generally, some food is properly and necessarily taken, even before rising from bed in the morning, and at all events as soon after rising as may be, and before any exertion is made; and in default of this indulgence, the system is found to be deranged,

and the functional processes disturbed, during the remainder of the day. These are, however, extreme cases; and cases in which the habit of taking food before rising in the morning has been merely acquired by indolence and self-indulgence, should not be mistaken for them. If the interval of time between rising in the morning and the breakfast, be not long enough to expend unwisely, or somewhat exhaust, the nervous energies, the meal may usually be more substantial in quality and quantity, the longer the time, and the greater the amount of bodily or mental exercise undergone, before the breakfast.

The breakfast is very properly made to consist of a considerable proportion of liquids, to supply the loss of the fluids of the body during the hours of sleep; and along with the liquids, should generally be taken a large proportion of the solid food required for the support of the system during the twenty-four hours. And this, for more than one important reason. The nervous system is restored by sleep to its fullest power and activity; the equilibrium of its different endowments is regained; and all the organic processes are fitted for their offices in a corresponding degree. Hence the importance of appetite for the breakfast, as a criterion of unimpaired health, and the greater chance of the food then taken being assimilated without apparent disturbance of the digestive organs, or any evident tax upon the powers of the economy. But, in addition to this very sufficient reason for making the breakfast consist of an

important part of the day's bill of fare, may be mentioned, the great effcet of light on all the functions of the body, and likewise the importance of the long interval between the early meal of the day and the hours of sleep, as additional reasons and motives for attaching so mueh importanee to the breakfast. Granting that any one who undergoes a fair share of mental and bodily exertion, should eat a given quantity of animal food every day, diluting this, for the purposes of respiration, &e., with vegetable food, the advisibility of dividing this quantity into two parts, one of which is taken when the powers of the body are in the fittest state to assimilate it duly, and the other after a reasonable interval, and before the nervous system has become expended by its mental and bodily labours, may suggest itself reasonably to any one. The animal food may consist, aecording to circumstances, of cold or broiled meat, fish, eggs, bacon, and the like,—adapting the kind, as well as the quantity, to the powers of the stomaeh, and the probable wants and expenditure of the body; and this is dilutcd with any required quantity of farinaeeous food. Whether the liquid taken at breakfast be tea, coffee, eoeoa, choeolate, milk, gruel, or barley water, or eold water, must depend on the state of the digestivc organs, and the powers and organie sensibilities of the systcm. The *quantity* of liquid should likewise be carefully adapted to the state and wants of the system; remcmbcring that the separate absorption of the liquid food from the stomaeh may interfcre with and derange the digestive proeess in

many instances,—and in most cases, if the liquids be taken in an undue quantity.

The second meal should be taken some four or five hours after the breakfast. It should embrace almost all the remainder of the food not taken at breakfast, that is required by the economy during the twenty-four hours,—whether fashion and circumstances allow this meal to be called dinner or not. How exceedingly unwise it must be to fast longer than five hours, during those hours of the day when the mental and bodily expenditure is the greatest,—to task them unduly, and so far exhaust the powers of the economy,—is an evident and important truth; and the usefulness of taking the large proportion of the alimentary supplies so long a time before the hour of sleep, as will almost prevent, and certainly much diminish, the chance of going to sleep with undigested food in the stomach, in such a degree of crudity as may interfere with the soundness and perfectness of the sleep, and its restorative and equalising influence on the nervous and vascular and organic processes,—is very obvious; and the desirableness of the food being taken before the nervous energies are otherwise in great part expended by the mental and muscular labours, only to be restored after another night's sleep, is, again, a cogent reason for dining, or virtually dining, in the middle of the day, or as near to the middle of the day as may be. That anomalous meal, luncheon, becomes necessary or desirable, if the dinner cannot be taken about five hours after the breakfast; and if, breakfasting at eight, nine, or ten,

in the morning, a man, especially if he be a dyspeptic, cannot dine before five, six, or seven in the evening, not only should he eat luncheon at twelve, one, or two o'clock, but he should virtually dine at the luncheon, or eat at that time the larger proportion of his alimentary supplies,—leaving as little as may be to be eaten at hours so much nearer to his bed-time.

It is usually unwise to sleep soon after any of the meals. It risks the formation of an imperfectly concocted chyme, and the passage of undissolved and unmixed food into the bowels,—and consequent derangement of the second digestion, and interference with the ultimate assimilation of the food,—and possible disturbance of the prima via. But the advisability of remaining still for some longer or shorter time after eating, is not thereby affected. The fact remains, that, during the first stage of the digestive processes, a large quantity of blood is determined to the stomach, to produce the secretion of the gastric juice, to *reduce* the chemical condition of the different articles of food, to dissolve the alimentary atoms, and prepare them for assimilation,—and that, if there be any doubt as to the general vigour and activity of the system, or as to the power and healthiness of the digestive organs, there should be no diversion of the blood thus determined to the stomach; an effect which muscular exercise, or setting the mind to work upon any engrossing and thought-requiring subject, must necessarily risk. The time necessary to be so devoted to non-interference with the stomach's functions, varies according to the degree of general

debility, or the feebleness or derangement of the digestive organs: it may be said to be, from half-an-hour to two hours. After this, exercise, especially bodily exercise, and more particularly if taken in the open air, assists the processes of assimilation, by promoting the action of the capillaries, and the general expenditure of the system, as well as by equalising the circulation, and diminishing the chance of irregular distribution of the blood.

The dinner very properly contains a smaller quantity of liquid matter than the breakfast; both because the system probably requires less liquid ingesta at that time of the day, and because, when not needful, liquids tend to interfere with the digestion of the solid aliment. In fact, if the stomach is feeble, or otherwise disordered in its functions, it may be wise or needful to take what liquids the system requires between the meals, rather than along with them. Liquids ought, moreover, to be rather taken before eating, than either at the same time with the solid food, or soon thereafter. It would have been said at one time, to be injudicious to drink before eating, from the idea that, in this way, the gastric juice might be diluted, and its solvent powers by so much weakened. This is now known to be a false objection; because the gastric juice is only secreted, when the aliment is in contact with the lining membrane of the stomach.

Every sufferer from indigestion, in any of its forms, should be restricted to one or at most two dishes at a meal. The multiplicity of dishes tempts the appetite to overload the stomach; but, in addition to this, the

stomach digests more quickly a single dish, even of somewhat difficult digestion, than a mixture of dishes that are digested more easily.

> "But other ills, th' ambiguous feast pursue,
> Besides provoking the lascivious taste.
> Such various foods, tho' harmless each alone,
> Each other violate ; and oft we see
> What strife is brew'd, and what pernicious bane,
> From combinations of innoxious things."
>
> ARMSTRONG.

Dishes which are composed of a great variety of articles, are properly included under this head. The simpler the dish to which the dyspeptic confines himself, the less likely is he to feel its digestion. There is no question, however, that cookery plays an important part, in subserving or interfering with the functions of the stomach; or that some of the results of the continental mode of cookery, when not spoiled by the addition of oils or acids, are more easily digested than the plain roasted and boiled meats of the English cook. This is probably a question of the mechanical condition of the animal fibre, and its being made more tender and soluble, instead of more hard, by the culinary processes; and not a question as to the complexity or simplicity of the dish that is eaten.

The more thoroughly the food is masticated, the more quickly and easily it is digested. Indigestion very commonly comes on, when people are losing their teeth, and are consequently unable, from irritation of the gums, to chew their food properly. Horses become emaciated and out of health from a

similar cause,—from inequalities of the surfaces of the teeth, which prevent the perfect mastication of the food. It has even been said, and perhaps justly, by distinguished naturalists, that the loss of the teeth, and the consequent imperfect mastication of the food, is the principal cause of the shortness of the life of many of the lower animals. Cases of indigestion are of frequent occurrence, which are wholly attributable to the common practice of eating the meals too quickly, and the consequent swallowing of the food in large and imperfectly chewed masses.* Food that is so taken into the stomach, is

* A medical man who had paid considerable attention to dental surgery, assured me, that one of the greatest causes of the early decay and consequent loss of the teeth which so generally prevails, is, that they are too close together. He says, "that, although fixed in their sockets, the teeth still yield somewhat during the mastication of food,—that their mode of connection with the alveolar processes renders them more or less elastic,—enabling them to recede in some degree before the resisting body:" a beautiful provision to prevent unnecessary friction, and so to prevent or diminish the wearing away of the enamel. He says, "that when the teeth are too close together, the rubbing of the teeth on one another during mastication wears away or cracks the enamel that is between them, by which the bony structure is exposed, and the teeth decay." He drew the rational inference, that, for this among other reasons, the teeth of young people, from their eighth or ninth to their eleventh or twelfth year, should be occasionally examined; and that, when this undue proximity of the teeth to one another is found to obtain, one should be removed from each side of the over-filled jaw. He contended, that, by this simple means, the teeth would, to a very great degree, be prevented from decaying prematurely, while the set would be rendered more regular and uniform, and the teeth would, of course, at that early age, so accommodate themselves to the additional room thus given to them, that there would be eventually no perceptible gap at the places from which the teeth had been extracted. For obvious reasons, he prefers removing the first or second molar teeth. There is probably much

not thoroughly mixed with saliva; and the great assistance which this important secretion renders to the complex processes of digestion is thereby lost. In the case of the farinaceous foods, this will be understood to be peculiarly important. But the usefulness of a due mastication of the food is by no means confined, in the case of man, to the farinaceous articles of food. It is almost equally evident in the case of animal fibre, when the effect of mastication may be simply mechanical, and have little to do with the admixture with the saliva; and many dyspeptic cases connected with imperfect mastication, either from a long habit of eating rapidly, or from the defective condition of the teeth, are much relieved by directing the meat to be pounded or chopped into small pieces by the cook, and served up, plainly cooked, in this state. A strong extract of meat,—made by mixing pounded animal fibre, free from skin or fat, with its own weight of cold water; rubbing them thoroughly together, to secure the solution of all the soluble matters; gradually heating the mixture to the boiling point; allowing it to boil for a few minutes; and straining the extract from the hard and coagulated albuminous and fibrinous remainder,—affords an animal matter,

important truth in these views as to the cases of the decay of the teeth, which commences in the surfaces which are in contact with the other teeth. It could not be applicable to the cases in which the caries begins at the top of the crown of a tooth. The observation, however, seems to be so feasible, and is probably applicable to so many cases, that, if true, it cannot be too generally known.

of highly nutrimentary character, which contains, according to Professor Liebig, a mixture of albumen and gelatin, nearly one-half being an absolute albumen. Nearly one-fourth of the whole solid or non-aqueous substance of the meat is thus extracted; and a much larger proportion of the animal matter that is convertible by the organs of digestion into aliment. In such cases as those referred to, in which, whether from decay of the teeth or other causes, a due mastication is not afforded to the solid animal fibre, to facilitate its digestion in a sufficient degree, the use of such an extract, either alone, or mixed at discretion with other viands, might prove to be an exceedingly valuable and desirable addition to the dietary.

But food ought not to be eaten quickly, for another reason. It is important to eat slowly, because there is thus less danger of eating to repletion,—of taking more food at one time, than the stomach can easily digest. If food is eaten slowly, a distinct sensation is felt when enough has been taken. If food is eaten faster, this sensation is either not perceived until too much has been taken, or it is not attended to.

The quantity of food made use of, is of no less importance than its digestibility, simplicity, mode of cookery, and due mastication, to the healthy condition of the digestive organs and of the system generally. The great and good Dr. Fothergill, in one of his papers, says, "Nothing is of so much consequence to invalids, and the more delicate of both sexes, as attention to

quantity. There are many people who seem to be possessed of such powers of digestion, as to be under no restraint on that account, and who never feel themselves incommoded, either with the quantity, or the most heterogeneous qualities of their food. They rise from the most plentiful mixed and rich repasts, without any kind of apparent uneasiness. But this is not the case with the generality—they are affected with uneasiness, some in one way, some another, by the unnatural load. And how often do we hear such complaining of the ill effects of this or that particular kind of diet, when, perhaps, their sufferings arise from the quantity of all, rather than the disagreement of any. It demands attention to observe that just medium, and no less resolution to keep to it, which the stomach invariably points out in respect to quality. The *how much* must be determined by every individual." In reference to this question, I may be permitted to quote the following from Dr. M'Cabe's able work "On the Cheltenham Waters, and the Diseases in which they are recommended."—"It is surprising, and deserves to be generally known, what a small quantity of food is necessary, not only to preserve life, but also to maintain perfect health. As the particular application of a fact has more weight than its general assertion, we shall here mention a circumstance which Dr. Gregory, of Edinburgh, was in the habit of relating, in his lectures on the practice of medicine, which is strongly illustrative of the position above advanced. Some European troops, in the

East Indies, were, by the chances of war, reduced to the necessity of subsisting for a considerable time on the scanty allowance of about two ounces of rice daily. Among them were some officers who had long been accustomed to the luxurious mode of living usually adopted by Europeans in the East. When first reduced to this scanty allowance, they expected that death would shortly relieve them from their miserable condition; but they were agreeably surprised to find, day after day, that they still retained their health and vigour; and after the expiration of several months, during which time they had lived on this scanty allowance, they were all in perfect health. This celebrated physician went farther; he said, that some of them, who at the commencement of their involuntary abstinence were pallid, sallow, and emaciated, with all the other symptoms which usually characterise chronic diseases of the liver, at the time of their liberation were considerably improved both in health and general appearance." This case is interesting, and in some degree illustrative of this question, both from the degree to which the involuntary abstemiousness was carried, and the length of time during which it had to be endured. But the climate of India, involving the consumption of so much less carbon for the maintenance of the animal heat, and the probably small amount of exertion whether mental or bodily these troops would be called upon to undergo, make a large deduction necessary, in applying the facts to the climate of

Great Britain, and to the ordinary circumstances of life. There can, however, be no doubt, that the tendency, especially among the middle and upper classes of the people, and among the more sedentary, is to eat too much, more than is required to meet and compensate for the expenditure of the system; that this excess of food, either loads the system unduly and unwisely, or tasks the emulging organs with extra duty for its elimination; failing which, disordered action must ensue. That there are exceptions to this, however, and an opposite side to this picture, is likewise true; that there are men, whose labours of mind, and sometimes, although more seldom, of body likewise, are so great, that the nervous energies are so far expended by these exertions, as to rob unfairly, and at their proper peril, the digestive processes of their share of vitalising influence, I know to be true: I have seen cases of this kind, in which the stomach has been so feeble, and the powers of assimilation so much deranged, that the system has been restricted to a minimum quantity of farinaceous food, in order that there might have to be expended in the digestion as little as possible of the power sought to be devoted to the business of the life. It need not be said, that the end, in all such cases, must be the same; that the machine must be injured by all excesses, whether intellectual or otherwise; that the great processes of reproduction and expenditure become less and less equal to the maintenance of organic power, or even of life; and that

disease must be the certain, and not very remote consequence. Such cases must enlist more of our sympathy, than those of the glutton or the drunkard; but they involve at least an equal infraction of the organic laws, and afford equally important beacons to warn men from such dangerous courses. Man is, under all circumstances, largely the creature of his organisation; in consonance with the requirements of which he must live, if he is to mantain his health, and consequently his power, opportunity, and length of time, for usefulness, and for the attainment of his object,—whether that object be high or low, selfish or philanthropical, ennobling or otherwise.

The quantity of food upon which life may be maintained for considerable periods of time, is shown to be small, by many well authenticated instances of privation, from the consequences of shipwreck, &c. In the well-known instance of "The mutiny of the Bounty," eighteen men were kept alive, at an admitted point just above that of actual starvation, on an allowance per man of four ounces of bread per day, divided into three portions, and consumed in the morning, at noon, and at sunset. This fearfully low scale of diet, improved by the occasional addition of half an ounce of pork, or the quarter of the kernel of a cocoa nut, was virtually more low and meagre than it appears to be, from the statement that the bread was in a great degree spoiled by exposure to wet, and is called in the "eventful history," rotten and decayed; that the

quantity of water issued to every man per day had to be limited to less than a pint; that the poor fellows were exposed in an open boat night and day, and had to endure the extremes of cold, some degree of labour, loss of sleep, and the like. Their case was made worse, moreover, by their having had to throw away, early in their awful time of suffering, all superfluous clothes, in order to lighten the boat,—and by their defenceless exposure to wind and rain during part of the subsequent time. The single comfort spoken of, is a small quantity of rum,—which, although only sufficient to be served out in quantities of a teaspoonful to each, relieved the sense of cold and exhaustion, when it became extreme and alarming. This state of misery continued during twenty-three days, and was survived by all the men. This case and such cases are matters, however, rather of curious experience, than of practical interest.

In gaols, the inmates are said to have been kept in health and strength, on a daily allowance to every individual of—1st, nine pounds of potatoes, a pint of new milk, and a pint of butter milk; or, 2nd, of two pounds of bread and a quart of new milk; or, 3rd, of eight ounces of oatmeal, made into stirabout, four pounds of potatoes, a pint of new milk, and a pint of butter-milk; or, 4th, in an instance of people who had to work, of thirteen ounces of oatmeal, two and a half pounds of potatoes, and two and a half pints of buttermilk.* These, however, are examples of dieting

* Report, by Sir David Barry and Dr. Corrie, on the System of Public Medical Relief in Ireland.

without the use of flesh-meat; and are rather, it should be observed, indications of how little food may serve to keep men in a certain degree of health, than satisfactory guides to a fit diet for those who are not criminals, and deserve to be liberally provided for, and yet not more so than is found to consist with the maintenance of health. Such a scheme of diet appears to be the one used in the British navy.

DIETARY OF THE BRITISH NAVY.

The provisions allowed daily to every person serving in her Majesty's ships, consist of—

Bread	1 lb.
Beer	1 gal.
Cocoa	1 oz.
Sugar	$1\frac{1}{2}$ oz.
Fresh meat and	1 lb.
Vegetables	$0\frac{1}{2}$ lb.
Tea	$0\frac{1}{4}$ oz.

When fresh meat and vegetables are not issued, there is, in lieu thereof—

Salt beef and	$0\frac{3}{4}$ lb.	Alternately.
Flour or	$0\frac{3}{4}$ lb.	
Salt pork and	$0\frac{3}{4}$ lb.	
Peas	$\frac{1}{2}$ pint	

And, weekly, whether fresh or salt meat is used—

A quantity of	Oatmeal	not exceeding	$\frac{1}{2}$ pint,	for occasional use, and only paid for when used.
	Vinegar		$\frac{1}{2}$ pint,	

The following scheme shows the proportion of provisions, with salt meat for each man, for fourteen days :—

Days of the Week.	Bread.	Beer.	Sugar.	Cocoa.	Tea.	Beef.	Pork.	Flour.	Peas.	Oatmeal and Vinegar, Pints each.
	lb.	gal.	oz.	oz.	oz.	lb.	lb.	lb.	pt.	
Sunday	1	1	1½	1	¼	¾	—	¾	—	½
Monday	1	1	1½	1	¼	—	¾	—	½	
Tuesday	1	1	1½	1	¼	¾	—	¾	—	
Wednesday	1	1	1½	1	¼	—	¾	—	½	
Thursday	1	1	1½	1	¼	¾	—	¾	—	
Friday	1	1	1½	1	¼	—	¾	—	½	
Saturday	1	1	1½	1	¼	¾	—	¾	—	
Sunday	1	1	1½	1	¼	—	¾	—	½	½ As explained above.
Monday	1	1	1½	1	¼	¾	—	¾	—	
Tuesday	1	1	1½	1	¼	—	¾	—	½	
Wednesday	1	1	1½	1	¼	¾	—	¾	—	
Thursday	1	1	1½	1	¼	—	¾	—	½	
Friday	1	1	1½	1	¼	¾	—	¾	—	
Saturday	1	1	1½	1	¼	—	¾	—	½	
Proportion for 14 days	14	14	21	14	3½	5¼	5¼	5¼	3½	

On the days on which flour is issued, suet, and raisins or currants, may be substituted for a portion of the flour; 1 lb. of raisins, or ½ lb. of currants, or ½ lb. of suet, being considered equal to 1 lb. of flour.

When it is necessary or expedient to alter any of the kinds of provisions, and to issue others as their substitutes, it is observed, that—

1½ lb. of soft bread, or . . . . }
1 lb. of rice, or . . . . } is to be considered equal to 1 lb. of biscuit.
1 lb. of flour . . . . }

1 pint of wine, or . . . . }
¼ pint of spirits . . . . } is to be considered equal to 1 gallon of beer.

1 oz. of coffee, or . . . . }
½ oz. of tea . . . . } equal to 1 oz. of cocoa.

1 lb. of rice, or . . . . }
1 pint of calavances, or . . }
1 pint of dholl . . . . } equal to 1 pint of peas.

1 lb. of rice equal to 1 quart of oatmeal

1 lb. of butter equal to 1 lb. of sugar.
2 lbs. of cheese equal to 1 lb. of cocoa.
¼ lb. of onions, or . . . } equal to 1 lb. of other vegetables.
¼ lb. of leeks . . . . }

When salted meat has been used for fourteen days, lemon juice, with an additional allowance of sugar, is issued, as an antiscorbutic.

The following is the table of diet used in the Naval Hospitals, and Marine Infirmaries :—

Full Diet.	Half Diet.	Low Diet.	Fever Diet.
Bread, 1 lb. Beef or mutton, 1 lb. Potatoes or greens, 1 lb. Herbs for broth, 25 drms. Barley, 14 drms. Salt, 8 drms. Vinegar, 16 drms. Tea, 4 drms. Sugar, 16 drms. Milk for tea, ⅔ pint. Broth, 1 pint.	Bread, 1 lb. Beef or mutton, 8 oz. Potatoes or greens, 8 oz. Herbs for broth, 25 drs. Barley, 14 drms. Salt, 8 drms. Vinegar, 16 drms. Tea, 4 drms. Sugar, 16 drms. Milk for tea, ⅔ pint. Broth, 1 pint.	Bread 8 oz. Herbs for broth, 12½ drms. Barley, 7 drms. Salt, 8 dr. Tea, 4 dr. Sugar, 16 drms. Milk for tea, ⅔ pint. Milk for diet, 1 pt. Broth, ½ pt.	Bread 8 oz. or Sago, 4 oz. Tea, 4 dr. Sgr. 20 dr. Milk for tea, ⅔ pint. Milk for diet, ½ pint
HOME. Beer (small), 2 pints. Or strong, 1½ pint.	HOME. Beer (small), 1¼ pint. Or strong, 1 pint.		
FOREIGN. Wine or Porter { at the surgeon's discretion, not exceeding } 1 pt. 1½ pt.	FOREIGN. Wine at the surgeon's discretion, not exceeding } 1 pt.		
Veal. Fowls. Fish. { Such quantities, in lieu of beef and mutton, as may be prescribed.			

*** Rice or flour pudding at the discretion of the medical officer.

NOTE.—Two drachms of tea, eight drachms of sugar, and one-sixth of a pint of milk, to be the allowance for a pint of tea to each patient, morning and evening. The meat for the full and half diet to be boiled together with fourteen drachms of Scotch barley, eight drachms of onions, one drachm of parsley, and sixteen drachms of cabbage, for every pint of broth ; or, at the discretion of the medical officers, eight drachms of carrots, and eight drachms of turnips, in lieu of the cabbage; and thus will be made a sufficient quantity of good broth, to allow a pint to each on full and half diet, and half a pint to each on low diet.

RICE PUDDING—EACH TO CONTAIN		FLOUR PUDDING—EACH TO CONTAIN	
Rice	3 oz.	Flour	4 oz.
Sugar	1 oz.	Sugar	1 oz.
Milk	¾ pint.	Milk	¾ pint.
Eggs	1 No.	Eggs	1 No.
Cinnamon	1 blade.	Ginger	a few grains.

The above tables of diet for the patients in the Naval Hospitals have been modified and improved by the following scheme of substitutes, which is adopted instead of that given above, when the fresh provisions are procurable :—

	DAILY.		
	Full Diet.	Half Diet.	Low Diet.
Soft bread	1 lb.	12 oz.	8 oz.
Beef	1 lb.	8 oz.	None.
Vegetables	1 lb.	8 oz	None.
Broth	1 pint.	1 pint.	½ pint
Barley for ditto	12 drs.	12 drs.	6 drs.
Or rice in lieu of barley	10 drs.	10 drs.	5 drs.
Potherbs	24 drs.	24 drs.	24 drs.
Salt	8 drs.	8 drs.	8 drs.
Vinegar	16 drs.	16 drs.	None.
Tea	3 drs.	3 drs.	3 drs
Sugar	14 drs.	14 drs.	14 drs.
Milk	⅓ pint.	⅓ pint.	1 pint.
Wine (at the discretion of the surgeon	—	—	—
Cocoa (as a substitute for tea)	1 oz.	1 oz.	1 oz.

These tables for the sick-dietary of the navy, are at once liberal and well considered. They supply a valuable guide; and in many cases may be taken, without alteration, as a standard of sick-dietary. The scheme of diet for the healthy in the naval service, is chiefly remarkable for the comparatively large allowance of animal food, and other substantial articles of diet. This, however, is probably rendered

necessary by the great exposure of the men to the open air, and to the air of the night in the watches,—by the considerable muscular exertions they have to undergo,—and, it must be added, by the depressing influence of the mephitic air of the between-decks, during the hours of sleep, with the men's hammocks in absolute contact with one another.

The above might be even sufficient to afford a guide to the scale of diet and quantity of food requisite for men in health, and undergoing a regular amount of exercise. To complete the rule, and adapt it to individuals variously circumstanced, as to climate, age, sex, social position, and habits of life, requires a knowledge and due consideration of all such circumstances. Cornaro found that he was in the best health, when living daily on twelve ounces of solid food and fourteen ounces of wine; Dr. Cheyne recommends eight ounces of flesh meat, twelve ounces of bread, and about a pint of wine, in the twenty-four hours; and some have considered two pounds of good bread, and three pounds of milk, to be sufficient for a working man. But all such observations are, in reality, loose, and of little value, without the habits and circumstances of the life are duly taken into consideration. The remarkable case of Thomas Wood, a miller, who lived at Billericay, in Essex, seems to be worth citing, as an illustration of the quantity of food upon which health and strength may, under some circum-

stances, be secured. This case was laid before the College of Physicians in 1767, by Sir George Baker. Thomas Wood appears to have been subject to various disorders, particularly rheumatism, until he was thirteen years of age. "He then had the small-pox in a favourable way; and from that time became healthy, and continued to have no complaints, to the age of about forty-three years. From his attaining the age of manhood to this period, but especially during the latter part of the time, he indulged himself, even to excess, in fat meat, of which he used to eat voraciously three times a day; together with large quantities of butter and cheese. Nor was he more cautious with respect to strong ale, which was his common drink. About his fortieth year, he began to grow very fat; but finding that he had a good appetite, and digested his food without difficulty, and that his sleep was undisturbed, he made no alteration in his diet." In his forty-fourth year, however, his sleep began to be disturbed, his digestion became impaired, the state of his bowels became irregular and uncertain, and he began to suffer from headache and vertigo. Moreover, he "had almost a constant thirst, a great lowness of spirits, violent rheumatism, and frequent attacks of the gout. He had likewise two epileptic fits; but the symptom which appeared to him to be the most formidable, was a sense of suffocation, which often came on him, particularly after his meals. Under such a complication of diseases, every day increasing,

he continued until the month of August, 1764," or about a year. At this time, the advice of a worthy clergyman, who lived in the neighbourhood, and the reading the Life of Cornaro, led him to think that intemperance might be the cause of his severe ailments. "However, he thought it prudent not to make a total change in his diet, suddenly and at once: accordingly, he at first confined himself to one pint only of his ale every day; and used animal food sparingly. This method he soon found to answer to his satisfaction; for he felt easier and lighter, and his spirits became less oppressed. These good effects encouraged him to proceed in his experiment; and therefore, after he had pursued the regimen before mentioned, during ten months, he deducted from his allowance half the former quantity of ale, and was still more sparing of gross animal food. In this course he continued till the 4th of January, 1765, since which time he has entirely left off all malt liquor; and, in the following month, he began to drink only water, and to eat none, except the lighter meats. Under this degree of abstinence, although some of his complaints were relieved, yet some of them remained in full force. The rheumatism tormented him; and he had still, now and then, slight fits of the gout. On the 4th of June following, he began the use of the cold bath; and continued it twice or thrice a week, until the 29th of October, 1767. About the same time he began the exercise of the dumb-bell; in which he perseveres to this day.

Water was his only drink from the beginning of January, 1765, to the 25th of the following Oetober. From this day he drank no more, until the 9th of May, 1766, when he drank two glasses and a half of water; sinee whieh, he has drank no more of any liquor whatever, exeept only what he has taken in the form of medieine. He has avoided eheese ever sinee the 30th day of June, 1767. He began to abstain from butter some time sooner. The 31st of July, in the same year, was the last time of his eating any animal flesh. Sinee that date, his diet has been prineipally eonfined to pudding made of sea biseuit. He allows himself very little sleep; generally going to bed at eight o'eloek in the evening, sometimes even earlier, and generally rising about one o'eloek in the morning, but being very rarely in bed after two o'eloek. Under this striet eourse of abstinenee he still eontinues to live; and he expresses, in the highest terms, the great pleasure and tranquillity of mind whieh he enjoys in eonsequenee of it. The poor diet to whieh he has aeeustomed himself, is now as agreeable to his palate, as his former food used to be; and he has the additional satisfaetion to find his health established, his spirits lively, his sleep no longer disturbed by frightful dreams; and his strength of museles so far improved, that he ean earry a quarter of a ton weight, whieh weight he in vain attempted to earry when he was about the age of thirty years. His voiee, whieh was entirely lost for several years, is now beeome elear and strong.

In short, to use his own expression, he is metamorphosed from a monster, to a person of moderate size; from the condition of an unhealthy, decrepit old man, to perfect health, and to the vigour and activity of youth." His exclusive diet for years, appears to have consisted of a pudding made of flour and water: the daily allowance being one pound of such flour as the coarser sorts of sea biscuit are made of, and as much water as would render it soft and tender. This pudding was boiled, and eaten at twice, without any addition whatever; the first half being taken at four or five o'clock in the morning, and the second half at noon. He neither required nor took any additional liquid, than that contained in the pudding. He lived in this way till May, 1783, enjoying good health in general; active, energetic, and industrious; advising all and sundry to follow his example; having become a living illustration of the value of temperance and moderation. During eighteen years and upwards, he had led a life of such remarkable abstemiousness; had more than regained the vigour of his youth; had put to flight a whole host of serious diseases; and demonstrated upon how small a quantity of food, and how simple a diet, life and health may be secured and enjoyed. Had Mr. Wood been equally cognizant of the importance of the other organic laws, his life might have been much longer spared to illustrate and spread such principles and practice. He admitted that it was the consideration of the imprudent indulgences of

his earlier life, and their fearful consequences on his system, together with the consideration of his having been forty-five years of age, when he entered on the different mode of living, that induced him to carry his degree of abstemiousness to so extreme a point. Mr. Wood died from a severe inflammatory attack, in May, 1783. Till then, he had continued in his wonted good health; when he caught cold by riding in the rain, with his coat and waistcoat unbuttoned, as usual; and thus brought on the inflammation from which he died. "A few days before his last illness, he had travelled on horseback more than sixty miles, without any sense of fatigue."

This case will be admitted to be remarkably interesting, as an illustration of how small a quantity of food may be really needful, for the maintenance of the health or power of the system. If two ounces be deducted from the sixteen ounces of flour used daily, as a probable average of the water contained in it,—the remaining fourteen ounces may be said, in round numbers, to contain three ounces of albuminous or azotised matter, adapted to the nutrition and general support of the organs and tissues of the body, and eleven ounces of amylaceous or non-azotised matter, singly and exclusively adapted to the uses of respiration; and to maintain the elevated temperature of the body, without injury or waste to its own organisation. I do not, however, conceive that a scale of diet such as that adopted by Mr. Wood, either as to its amount of nutriment or as to its sameness, would be generally

desirable or sanatory. On the contrary, it seems to be quite certain, that, in order to maintain the economy of the system in the condition of most efficient and absolute healthiness, the food should be varied in kind, and allowed in greater quantity than may be absolutely needful for the maintenance of temperature or the restoration of wasted tissue.

For the respiratory wants of the system, Professor Liebig assumes, from the results of experiments and by inference, "that an adult, taking moderate exercise, consumes 13·9 ounces of carbon daily;" or as much food as would contain sufficient carbon and hydrogen to supply twenty-four pounds of blood with these elements, for combination with the oxygen of the respired air, and the consequent maintenance of the animal heat; the consequent assumption being, that the whole of the blood undergoes this change in the course of four days and five hours. This estimate of the expenditure of carbon in the respiratory process and otherwise, is interesting as a guide to determine, in some degree, the dietetic wants of the system; ever bearing in mind the effect of climate, season, weather, temperature, and the amount of exercise taken daily, in modifying the wants and expenditure of the body.

Having already cited the diet tables adopted in the British Naval Service, and in the Naval Hospitals, I quote that circulated for use in the Regimental Hospitals, dated October, 1843:—

REGIMENTAL HOSPITAL DIETARY.

ARTICLES COMPOSING THE DIFFERENT DIETS FOR ONE DAY FOR ONE MAN.

Full Diet.	Half Diet.	Low Diet.	Spoon Diet.	Milk Diet.
12 oz. Meat.	8 oz. Meat.	4 oz. Meat.	8 oz. Bread.	14 oz. Bread
16 oz. Bread.	16 oz. Bread.	12 oz. Bread.	4 drs. Tea.	2 oz. Rice.
16 oz. Potatoes.	8 oz. Potatoes.	8 oz. Potatoes	1½ oz. Sugar.	3 pts. Milk.
1½ oz. Barley.	1½ oz. Barley.	1½ oz. Barley.	6 oz. Milk.	
½ oz. Salt.	½ oz. Salt.	½ oz. Salt.		
4 drs. Tea.	4 drs. Tea.	4 drs. Tea.		
1½ oz. Sugar.	1½ oz. Sugar.	1½ oz. Sugar.		
6 oz. Milk.	6 oz. Milk.	6 oz. Milk.		

NOTE.—The meat to be boiled so as to make a pint of good broth for the dinner of each patient, including small vegetables and pepper as usual.

DIET TABLE FOR ONE DAY FOR ONE MAN.

Meals.	If on Full Diet.	If on Half Diet.	If on Low Diet.	If on Spoon Diet.	If on Milk Diet.
Breakfast.	1 pint Tea. 6 oz. Bread.	1 pint Tea. 6 oz. Bread.	1 pint Tea. 4 oz. Bread.	1 pint Tea. 4 oz. Bread.	1 pt. Milk. 6 oz. Bread.
Dinner.	12 oz. Meat. 4 oz. Bread. 16 oz. Potatoes.	8 oz. Meat. 4 oz. Bread. 8 oz. Potatoes.	4 oz. Meat. 4 oz. Bread. 8 oz. Potatoes.	At medical discretion, as puddings.*	1 pt. Milk. 2 oz. Rice. 4 oz. Bread.
Supper.	1 pint Tea. 6 oz. Bread.	1 pint Tea. 6 oz. Bread.	1 pint Tea. 4 oz. Bread.	1 pint Tea. 4 oz. Bread.	1 pt. Milk. 4 oz. Bread.

REMARKS.—No extras to be given on full, half, or low diets, except wine, porter, or spirits. These to be given when required, in conformity with existing regulations.

* Puddings to consist of { 3 oz. rice, or 2 oz. sago, or 8 oz. bread, ½ pint milk, 1 oz. sugar, 1 egg. } Ginger or cinnamon, a few grains.

The Poor Law Commissioners for England and Wales, in their Second Annual Report, offered six different dietaries, to be selected from by the Boards of Guardians of the different Unions, according to the habits of living of the pauper and labouring population, in their respective districts. The different scales are equally set forth, as intended for the maintenance of able-bodied paupers:—

No. 1.—DIETARY FOR ABLE-BODIED PAUPERS.

		BREAKFAST.		DINNER.				SUPPER.		
		Bread.	Gruel.	Cooked Meat.	Potatoes.	Soup.	Suet or Rice Pudding.	Bread.	Cheese.	Broth.
		oz.	pints.	oz.	lb.	pints.	oz.	oz.	oz.	pts.
Sunday	Men	6	1½	5	½	—	—	6	—	1½
	Women	5	1½	5	½	—	—	5	—	1½
Monday	Men	6	1½	—	—	1½	—	6	2	—
	Women	5	1½	—	—	1½	—	5	2	—
Tuesday	Men	6	1½	5	½	—	—	6	—	1½
	Women	5	1½	5	½	—	—	5	—	1½
Wednesday	Men	6	1½	—	—	1½	—	6	2	—
	Women	5	1½	—	—	1½	—	5	2	—
Thursday	Men	6	1½	5	½	—	—	6	—	1½
	Women	5	1½	5	½	—	—	5	—	1½
Friday	Men	6	1½	—	—	—	14	6	2	—
	Women	5	1½	—	—	—	12	5	2	—
Saturday	Men	6	1½	—	—	1½	—	6	2	—
	Women	5	1½	—	—	1½	—	5	2	—

No. 2.—DIETARY FOR ABLE-BODIED PAUPERS.

		BREAKFAST.			DINNER.				SUPPER.		
		Bread.	Cheese.	Butter.	Meat Pudding.	Suet Pudding.	Bread.	Cheese.	Bread.	Cheese.	Butter.
		oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.
Sunday	Men	6	1	—	16	—	—	—	6	1	—
	Women	5	—	½	10	—	—	—	5	—	½
Monday	Men	6	1	—	—	—	7	1	6	1	—
	Women	5	—	½	—	—	7	1	5	—	½
Tuesday	Men	6	1	—	—	16	—	—	6	1	—
	Women	5	—	½	—	10	—	—	5	—	½
Wednesday	Men	6	1	—	—	—	7	1	6	1	—
	Women	5	—	½	—	—	7	1	5	—	½
Thursday	Men	6	1	—	—	—	7	1	6	1	—
	Women	5	—	½	—	—	7	1	5	—	½
Friday	Men	6	1	—	—	16	—	—	6	1	—
	Women	5	—	½	—	10	—	—	5	—	½
Saturday	Men	6	1	—	—	—	7	1	6	1	—
	Women	5	—	½	—	—	7	1	5	—	½

No. 3.—DIETARY FOR ABLE-BODIED PAUPERS.

		BREAKFAST.		DINNER.					SUPPER.	
		Bread.	Gruel.	Cooked Meat.	Potatoes and other Vegetables	Soup.	Bread.	Cheese.	Bread.	Cheese.
		oz.	pints.	oz.	lb.	pts.	oz.	oz.	oz.	oz.
Sunday	Men	8	1½	—	—	—	7	2	6	1½
	Women	6	1½	—	—	—	6	1½	5	1½
Monday	Men	8	1½	—	—	—	7	2	6	1½
	Women	6	1½	—	—	—	6	1½	5	1½
Tuesday	Men	8	1½	8	¾	—	—	—	6	1½
	Women	6	1½	6	¾	—	—	—	5	1½
Wednesday	Men	8	1½	—	—	—	7	2	6	1½
	Women	6	1½	—	—	—	6	1½	5	1½
Thursday	Men	8	1½	—	—	1½	6	—	6	1½
	Women	6	1½	—	—	1½	5	—	5	1½
Friday	Men	8	1½	—	—	—	7	2	6	1½
	Women	6	1½	—	—	—	6	1½	5	1½
Saturday	Men	8	1½	Bacon 5	¾	—	—	—	6	1½
	Women	6	1½	4	¾	—	—	—	5	1½

No. 4.—DIETARY FOR ABLE-BODIED PAUPERS.

		BREAKFAST.		DINNER.					SUPPER.	
		Bread.	Gruel.	Pickled Pork or Bacon.	Soup.	Bread.	Meat Pudding with Vegetables.	Rice or Suet Pudding.	Bread.	Cheese.
		oz.	pints.	oz.	pts.	oz.	oz.	oz.	oz.	oz.
Sunday	Men	8	1½	—	2	6	—	—	6	2
	Women	6	1½	—	1½	5	—	—	5	1½
Monday	Men	8	1½	—	—	—	—	12	6	2
	Women	6	1½	—	—	—	—	10	5	1½
Tuesday	Men	8	1½	—	2	6	—	—	6	2
	Women	6	1½	—	1½	5	—	—	5	1½
Wednesday	Men	8	1½	6	—	—	—	—	6	2
	Women	6	1½	5	—	—	—	—	5	1½
Thursday	Men	8	1½	—	—	—	—	12	6	2
	Women	6	1½	—	—	—	—	10	5	1½
Friday	Men	8	1½	—	2	6	—	—	6	2
	Women	6	1½	—	1½	5	—	—	5	1½
Saturday	Men	8	1½	—	—	—	12	—	6	2
	Women	6	1½	—	—	—	10	—	5	1½

No. 5.—DIETARY FOR ABLE-BODIED PAUPERS.

		BREAKFAST.		DINNER.						SUPPER.		
		Bread.	Gruel or Porridge.	Cooked Meat.	Vegetables.	Soup.	Boiled Rice or Suet Pudding.	Bread.	Cheese.	Bread.	Potatoes.	Cheese.
		oz.	pts.	oz.	lb.	oz.	oz.	oz.	oz.	oz.	lb.	oz.
Sunday	Men	7	1½	5	¾	—	—	—	—	7	—	1½
	Women	6	1½	5	¾	—	—	—	—	6	—	1½
Monday	Men	7	1½	—	—	1½	—	7	—	—	¾	—
	Women	6	1½	—	—	1½	—	6	—	—	¾	—
Tuesday	Men	7	1½	—	—	—	14	—	—	7	—	1½
	Women	6	1½	—	—	—	12	—	—	6	—	1½
Wednesday	Men	7	1½	—	—	—	—	7	2	—	¾	—
	Women	6	1½	—	—	—	—	6	2	—	¾	—
Thursday	Men	7	1½	5	¾	—	—	—	—	7	—	1½
	Women	6	1½	5	¾	—	—	—	—	6	—	1½
Friday	Men	7	1½	—	—	1½	—	7	—	—	¾	—
	Women	6	1½	—	—	1½	—	6	—	—	¾	—
Saturday	Men	7	1½	—	—	—	—	7	2	—	¾	—
	Women	6	1½	—	—	—	—	6	2	—	¾	—

No. 6.—DIETARY FOR ABLE-BODIED PAUPERS.

		BREAKFAST.			DINNER.						SUPPER.			
		Bread.	Cheese.	Butter.	Boiled Meat.	Potatoes.	Yeast Dumplings.	Suet Pudding.	Bread.	Cheese.	Bread.	Cheese.	Butter.	Broth.
		oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	oz.	pts.
Sunday	Men	6	1	—	—	—	—	16	—	—	6	1	—	—
	Women	5	—	½	—	—	—	12	—	—	5	—	½	—
Monday	Men	6	1	—	—	—	—	—	6	1	6	1	—	—
	Women	5	—	½	—	—	—	—	6	1	5	—	½	—
Tuesday	Men	6	1	—	4	12	5½	—	—	—	6	—	—	1
	Women	5	—	½	4	12	5½	—	—	—	5	—	—	1
Wednesday	Men	6	1	—	—	—	—	—	6	1	6	1	—	—
	Women	5	—	½	—	—	—	—	6	1	5	—	½	—
Thursday	Men	6	1	—	4	12	5½	—	—	—	6	—	—	1
	Women	5	—	½	4	12	5½	—	—	—	5	—	—	1
Friday	Men	6	1	—	—	—	11	—	—	—	6	1	—	—
	Women	5	—	½	—	—	11	—	—	—	5	—	½	—
Saturday	Men	6	1	—	—	—	—	—	6	1	6	1	—	—
	Women	5	—	½	—	—	—	—	6	1	5	—	½	—

In the same year's Report of the Poor Law Commissioners, Mr. Mott makes some interesting observations upon these dietaries. He supposes that No. 1 contains an average daily allowance of nineteen ounces of nutritive matter; No. 2, twenty-five and a half ounces; No. 3, twenty-four ounces; No. 4, twenty-six ounces; No. 5, twenty ounces; No. 6, twenty-three and a half ounces. These conclusions are founded upon somewhat exaggerated data, as to the relative dry nutriment contained in the principal articles of the dietaries; but the same observation seems to be equally applicable to the instances of the amount of food that is consumed by labourers and operatives in the rural and town districts; which Mr. Mott cites fairly enough as evidence of the sufficiency of the dietaries to support and maintain the health of the system. The conclusion at which Mr. Mott arrives, after much painstaking inquiry, is, that agricultural labourers are subsisted on an average upon 140 ounces of food per week,—"say, 134 ounces of bread and six ounces of meat." He found that in the food consumed by mechanics, in receipt of a much larger income, and sufficient means of procuring whatever amount of food the requirements of the system might demand, the food consisted of a much larger proportion of animal food; but, according to his data, did not contain more than sixteen ounces of nutritive matter per day, on the average; and this, even in the case of the better classes of mechanics, in the receipt of high wages, and consequently enjoying some of what may be termed the luxuries of life. Even in

the instance of mowers, sawyers, and prize-fighters when training, Mr. Mott seems to have ascertained, that, according to his data, the food consumed did not average more than "twenty-seven to thirty ounces per day, equal to from twenty to twenty-three ounces of nutritive substance."

"The correctness of these conclusions," says Mr. Mott, "respecting the quantities of food requisite for the various descriptions of labourers and others, was proved by Captain Sir Edward Parry on his last North Polar expedition, when it was expedient to limit the weight of the stock of provisions and other necessaries, for the boats'-crews, to facilitate their movements. Sir Edward Parry, for some time before he commenced his harassing journey across the ice, placed himself, his officers and crew, on a limited allowance of food daily; and it was found that ten ounces of biscuit, with nine ounces of pemmican, or animal food dried and powdered, and one ounce of cocoa, making together twenty ounces daily, were amply sufficient to support them under the ordinary exertions of sailors performing the regular ship duties. This quantity corresponds, as nearly as possible, with that consumed by our labourers and mechanics, namely, sixteen ounces of nutritive matter daily for each person. It is generally admitted that the digestive organs are influenced by climate, and that in the colder regions a proportionate increase in the quantity of food is necessary for man; and on trial it was proved, that to support the harassing and exhausting labour of drawing the boats over the ice, twenty ounces were insufficient; but Sir Edward

Parry states, that it was agreed by all hands that an addition of one-third of that quantity, that is to say, twenty-seven or twenty-eight ounces per day, would have been amply sufficient to have supported them even under all their hardships in that climate. Now this is equal to about twenty-two or twenty-three ounces of nutritive matter daily, and corresponds exactly with the quantity before stated as requisite for mowers, sawyers, pugilists when training, and others when enduring great bodily exertion. It would thus appear that, under no circumstances to which men, taken generally, are exposed, is a larger quantity than thirty ounces of solid food per day necessary, not exceeding twenty-three ounces of nutritive matter."

Mr. Mott adds to these interesting observations the following inferences:—"Much, I admit, depends upon constitution and the nature of their employment. I submit, however, that although, even for persons in full health, it would be difficult, perhaps impossible, to establish any given quantity of food to suit the capabilities of every stomach, it is possible so to classify them, as to form a tolerably correct rule for the whole. I have been led to believe that the result shown in the following scale may be considered as a fair estimate of the proportions of food requisite to support human life in a sound and healthy state. 1st. For persons of moderate health and constitution, but using little exercise or exertion: daily allowance of food, twelve to eighteen ounces; in nutritive matter equal to an average daily of ten ounces. 2nd. For persons of good health,

accustomed to moderate labour, as sailors and soldiers, on ordinary peace duty, or agricultural labourers or mechanics at their usual work: daily allowance of food, eighteen to twenty-four ounces; in nutritive matter equal to an average daily of ten ounces. 3rd. For persons subject to hard labour or other violent exertion, in good bodily health: twenty-four to thirty ounces of food: equal to twenty-two ounces of nutritive matter. The foregoing calculations have been made from data taken from cases indiscriminately, and I have reason to believe they will bear the test of examination; but round numbers are seldom correct, and I must beg again to disclaim any intention of offering them as infallible."

Making every needful allowance for the scarcely avoidable leaning to an under-estimate of the wants of the system, from official position; and for incorrect deductions, from deficient chemical and medical information; these facts and inferences are well worthy of a place in any attempt to estimate the quantity of food required by man, when placed in different circumstances as to climate and mode of life. It is, however, very evident, how little importance is attached in the above observations, to the relative amount of animal food contained in any dietary; and how little is thought of the form of animal or vegetable food that is made use of, and its consequent digestibility and nutrient power.

The diet tables found to be useful in the different hospitals or infirmaries, are valuable illustrations of the quantity of food required under different circumstances; and more especially valuable, inasmuch as

all the wants of the inmates of such establishments, are proverbially ministered to with liberal hands.

MIDDLESEX HOSPITAL.—DIET TABLE.

MEALS.	Meat Diet.		Soup Diet.	Milk Diet.	Simple Diet.
Daily. . .	12 oz. of bread.		12 oz. of bread.	12 oz. of bread.	6 oz. of bread.
Breakfast .	1 piut of milk.		1 pint of milk.	1 pint of milk.	1 pint of barley water.
	Physician's Patients.	*Surgeon's Patients.*			
Dinner . .	Four Days.—4 oz. of dressed meat (beef or mutton), roast and boiled, alternately. Three Days.—4 oz. of meat in soup. $\frac{1}{2}$ lb. of potatoes daily.	4 oz. of dressed meat (beef or mutton), roast and boiled, alternately; and $\frac{3}{4}$ lb. of potatoes daily.	1 pint of soup, made with 4 oz. of beef, alternately with 1 pint of broth with barley.	$\frac{1}{2}$ pint of milk, with rice pudding four days, and with batter pudding three days.	1 pint of gruel.
Supper . .	1 pint of gruel, alternately with 1 pint of broth with barley.		1 pint of gruel.	$\frac{1}{2}$ pint of milk, or 1 pint of gruel.	1 pint of barley water or gruel.
Cancer Diet	12 oz. of bread, $\frac{1}{2}$ lb. of meat, $\frac{1}{2}$ lb. of potatoes, 1 pint of milk.				

NORTHAMPTON GENERAL INFIRMARY.—DIET TABLE.

	Full Diet.	Half Diet.	Milk Diet.	Fever Diet.
Breakfast	1 pt. of milk porridge or broth.	1 pt. of milk porridge, or broth.	1 pt. of milk porridge.	Gruel, as required.
Dinner	4 oz. of meat, 1 pt. of broth, and vegetables at discretion.	2 oz. of meat, 1 pt. of broth, and vegetables at discretion.	1 pint of thickened milk.	Gruel, bread pudding, or rice pudding, as required; vegetables at discretion.
Supper	2 oz. of cheese, or 1 oz. of butter, on Wednesdays and Saturdays, for the week's consumption.	2 oz. of cheese, or 1 oz. of butter, on Wednesdays and Saturdays, for the week's consumption.	1 pint of milk.	1 oz. of butter, on Wednesdays and Saturdays, for the week's consumption, if required.
	14 oz. of bread daily. Three ½ pints of beer daily.	14 oz. of bread daily. 1 pint of beer daily.	7 ounces of bread daily. No beer.	bread as required. ½ pt. of milk if required. No beer.

MANCHESTER ROYAL INFIRMARY.—DIET TABLE.

	Generous.	Common.	Milk.	Low.
Breakfast.	1 pt. of tea. 6 oz. of bread. ¾ oz. of butter. Every day.	1 pt. of tea. 5 oz. of bread. ½ oz. of butter. Every day.	1 pt. of tea. 6 oz. of bread. ¾ oz. of butter. Every day.	1 pt. of tea. 3 oz. of bread. Every day.
Dinner.	8 oz. of beef or mutton, boiled or roasted. 8 oz. of potatoes or rice. 1 pint of beer. Monday, Wednesday, Friday } 8 oz. of rice. Tuesday, Thursday, Saturday, Sunday } 8 oz. of potatoes.	6 oz. of beef or mutton, boiled or roasted. 8 oz. of potatoes or rice. 3 oz. of bread. } 3 days. Tuesday, Thursday, Saturday, with rice, 8 oz. 1 pint of soup, thickened with meal, barley, or peas, with 2 oz. of meat in the soup. 8 oz. of pudding, made of bread, rice, sago, arrowroot, tapioca, batter, or suet pudding, sweetened. 3 oz. of bread. } 4 days, or Monday, Wednesday, Saturday, with potatoes, 8 oz. 8 oz. of white fish. 8 oz. of potatoes. 3 oz. of bread.—Friday. } 1 day. ½ pt. of table beer on meat and fish days.	½ pt. of milk. 12 oz. of farinaceous pudding, bread, sago, arrowroot, rice, tapioca, or batter pudding, sweetened. Every day.	1 pt. of gruel. 2 oz. of bread. Every day.
Supper.	1 pt. of milk pottage. 4 oz. of bread. Every day.	1 pt. of milk pottage. 4 oz. of bread. Every day.	1 pt. of milk pottage. 6 oz. of bread. Every day.	water gruel, or tea, alternately. 2 oz. of bread.

GLASGOW ROYAL INFIRMARY.—DIET TABLE.

	Full Diet.	Middle Diet No. 1.	Middle Diet No. 2.	Ordinary Diet.	Spoon Diet.	Milk Diet.
Breakfast .	4 oz. Oatmeal made into porridge, with 8 oz. sweet milk, or 16 oz. buttermilk.	Same as full.	Peas brose with sweet milk. Quantities same as full.	Same as full.	Tea or coffee, made with $\frac{1}{8}$ and $\frac{1}{4}$ of an ounce respectively; sugar $\frac{1}{4}$ oz., milk 1 oz., and bread 2 oz.	12 oz. milk. 3 oz. bread.
Dinner . .	16 oz. broth, 8 oz. meat, 8 oz. bread, or, 16 oz. potatoes.	16 oz. broth, 4 oz. meat, 8 oz. bread, or, 16 oz. potatoes.	Same as Middle No. 1, but with soup without vegetables.	Same as middle, No. 1, but without meat.	Bread 4 oz., into panado, with 1 oz. milk, and $\frac{1}{4}$ oz. sugar, or 2 oz. rice, 1 oz. of sago or arrowroot, or sowans, *ad libitum*; along with each of these latter rations, 8 oz. of sweet milk to be allowed.	16 oz. milk, 4 oz. bread, 2 oz. rice, or 1 oz. sago or arrowroot.
Supper . .	Same as breakfast.	Same as full.	Same as breakfast.	Same as breakfast.	Same as breakfast.	Same as breakfast.

EDINBURGH ROYAL INFIRMARY.—DIET TABLE. THE SIX MORE IMPORTANT SCALES OF DIET.

	Low.	Rice.	Steak.	Common.	Full.	Extra.
Break-fast.	Bread, 3 oz. Tea, ½ pint. { Tea ⅛ oz. Milk 1 oz. Sugar ½ oz.	Bread, 3 oz. Coffee, ½ pint. { Coffee ½ oz. Milk 2 oz. Sugar ½ oz.	Bread, 6 oz. Coffee, ½ pint. { Coffee ½ oz. Milk 2 oz. Sugar ½ oz.	Bread, 6 oz. Coffee, ½ pint. { Coffee ½ oz. Milk 2 oz. Sugar ½ oz.	Porridge, 1½ pt. made of oatmeal. } 4½ oz. Buttermilk, 1 pt.	Porridge, 2 pts. made of oatmeal. } 6 oz. Buttermilk, 1 pt.
Dinner.	Pana-do. { Bread 3 oz. Milk 2 oz. Sugar ¼ oz.	Beef Tea (from 8 oz. meat) } ⅘ pint. Rice pudding, made from—Rice, 1½ oz. Sugar, ½ oz. Milk, 2½ oz. Egg ½, 1 oz. Essential oil of lemon, 1 drop.	Potatoes, 16 oz. Beefsteak, 4 oz. Broth, 1 pint, made from—Barley, 1 oz. Vegetables, ¾ oz. Meat, 2 oz.	Potatoes, 16 oz. Broth, 1 pint, made from—Barley, 1 oz. Vegetables, ¾ oz. Meat, 2 oz.	Boiled meat, 6 oz. Potatoes, 16 oz. Bread, 3 oz. Broth, 1 pint, made from Barley, 1 oz. Vegetables, ¾ oz. Meat, 2 oz.	Boiled meat, 8 oz. Potatoes, 20 oz. Bread, 3 oz. Broth, 1 pint, made from Barley, 1 oz. Vegetables, ¾ oz. Meat, 2 oz.
Supper.	Bread, 3 oz. Tea, same as break-fast.	Bread, 3 oz. Tea, ½ pint. { Tea ⅛ oz. Milk 1 oz. Sugar ½ oz.	Bread, 6 oz. Tea, ½ pint. { Tea ⅛ oz. Milk 1 oz. Sugar ½ oz.	Bread, 6 oz. Tea, ½ pint. { Tea ⅛ oz. Milk 1 oz. Sugar ½ oz.	Potatoes, 16 oz. New milk, ⅓ pt.	Potatoes, 20 oz. New milk, ¾ pt.

I venture to consider this subject to be one of much and increasing importance, from the large number of people who are maintained in union-houses, hospitals, prisons, penitentiaries, &c.; and I shall accordingly cite a few more instances of public dietaries.

CHELSEA HOSPITAL.—ESTABLISHMENT OF DIET.

	Beef or Mutton.	Bread when Baked.	Potatoes.	Cocoa ready for use.	Sugar.
	oz.	oz.	oz.	oz.	oz.
To each man daily	13	16	13	¼	¾

Also an ounce of butter per man, on Wednesday and Friday in each week; and one pound of cheese weekly per man, at the rate of a quarter of a pound on each of the days which are fixed for the same being issued.

SCALES OF VICTUALLING FOR CONVICTS, &c.:—

For the Surgeon superintending, and to each Soldier of the Guard over Convicts, and to every Convict Settler, and Child, the following daily quantity of Provisions:—

SPECIES.	To the Surgeon superintending, and to each Soldier of the Guard over Convicts.	To each Male Convict, or Male Settler.	To each Female Convict, or Female Settler.	To each Child of Convicts or Settlers, under ten years of age.
Biscuit . .	1 lb.	⅔ lb.	⅔ lb.	½ lb.
Spirits . . .	¼ pint	—	—	—
Fresh Meat .	1 lb.	⅔ lb.	⅔ lb.	⅜ lb.
Vegetables . .	½ lb.	½ lb.	½ lb.	¼ lb.
Oatmeal . .	not more than ½ pt per week	⅕ pint.	—	—
Sugar . . .	1½ oz.	1½ oz.	1½ oz.	1 oz.
Chocolate .	1 oz.	⅜ oz., or	½ oz., or	¼ oz.
Tea . .	¼ oz.	¼ oz.	¼ oz.	—

Either three-eighths of an ounce of chocolate, or one quarter of an ounce of tea, is to be issued daily to each male convict, or male settler, viz., on one day chocolate, and on the following day tea, and so on alternatively.

When fresh meat and vegetables cannot be issued, these shall be allowed in lieu thereof, viz.—

SPECIES (On alternate days.)	To the Surgeon superintending, and to each Soldier of the Guard over Convicts.	To each Male Convict, or Male Settler.	To each Female Convict, or Female Settler.	To each Child of Convicts or Settlers, under ten years of age.
Salt Beef.	¾ lb.	½ lb.	⅓ lb.	¼ lb.
Flour .	¾ lb.	½ lb.	⅜ lb.	⅜ lb.
or				
Salt Pork	¾ lb.	½ lb.	⅓ lb.	⅓ lb.
Peas	½ pint	½ pint	½ pint	¼ pint
Flour . .	—	—	¼ lb.	¼ lb.

And weekly, whether fresh meat or salt meat be issued, vinegar not exceeding one half-pint per man a week, to the guard, &c., nor exceeding one quart for each mess of six other persons.

District Military Prisons.—Diet of Prisoners when not in Solitary Confinement.—Ordinary Diet.

Breakfast { 12 oz. of oatmeal, or 12 oz. of bread, and ½ pint of milk, daily.

Dinner . { 5 lbs. of potatoes, with salt, 1 pint of milk, daily.

On Sundays, the dinner of the first class to consist of ten ounces of beef, without bone, and after cooking, and two pounds of potatoes.

If in solitary confinement by sentence of a court-martial—

Breakfast { 10 oz. of oatmeal, or 10 oz. of bread, and ½ pint of milk, daily.

Dinner . { 4 lbs. of potatoes, with salt, and 1 pint of milk, daily.

If in solitary confinement for a prison offence, one pound of bread, with such quantity of water for drinking as a prisoner may desire to have—daily.

In gaols and houses of correction the dietaries are different, according to the terms of imprisonment; being lowest when the imprisonment is for shorter periods. The breakfast may be probably alike in all the classes; consisting of a pint or a pint and a half of gruel or porridge, and eight ounces of bread. The supper may be the same as the breakfast. The dinner, in the first class, viz. convicted prisoners, whose term of imprisonment does not exceed fourteen days, may consist of eight ounces of bread, and eight ounces of potatoes. In the second class, sentenced to imprisonment and hard labour for a term above fourteen days, and less than six weeks, the dinner may consist of three ounces of

cooked meat, without bone,—eight ounces of bread, —and eight ounces of potatoes,—every other day; the alternate day's dinner consisting of three ounces of beef, made into soup, with eight ounces of bread. In the third and fourth classes of prisoners, sentenced to hard labour for periods exceeding six weeks and three months respectively, the scale of diet is further raised by the addition of as much soup as would contain another ounce or more of beef to the dinner of the alternate days; and in the longer term of incarceration, of one or more ounces of solid animal food to the dinner of the intervening days.

Report on the Diet for Charity Workhouses in Scotland. By Drs. Alison and Christison. Dated, Edinburgh, 16th January, 1847.

	First rate, for the healthy who do not work.	Second rate, for the healthy who do not work.	Third rate, for the healthy who work.	Fourth rate, for the infirm.
Breakfast.	Oatmeal, 3 oz. Butter milk, or skimmed milk, $\frac{1}{2}$ pint	Oatmeal 4 oz. Butter milk, or skimmed milk, $\frac{3}{4}$ pint.	Same as second rate.	Oatmeal, 4 oz. Skimmed milk, $\frac{3}{4}$ pint.
Dinner.	Bread, 6 oz. Broth, $1\frac{1}{3}$ pint. { Ox head and Hough, $3\frac{1}{4}$ oz. or beef, excluding bone, 2 oz. Barley, 2 oz. Peas, $\frac{1}{2}$ oz. Vegetables, $1\frac{1}{2}$ oz. Salt—q. s. }	Bread, 8 oz. Broth, $1\frac{1}{3}$ pint, as in first rate.	Bread, 8 oz. Broth, $1\frac{1}{8}$ pint, as in first rate. Boiled meat, 4 oz.	Bread, 6 oz. Rice Soup { Rice, $1\frac{1}{2}$ oz. Beef, excluding bone, but not left in the soup, 5 oz. vegetables, 2 oz.: salt and pepper, q. s. } Boiled meat, 4 oz.
Supper.	Oatmeal, 3 oz. Butter milk, or skimmed milk, $\frac{1}{2}$ pint.	Oatmeal, 4 oz. Butter milk, or skimmed milk, $\frac{3}{4}$ pint.	Same as second rate.	Tea, $\frac{1}{3}$ pt. { Sugar, $\frac{1}{2}$ oz. New milk, 1 oz. Tea, $\frac{1}{8}$ oz. }

This question, as to the quantity of food that is necessary to the support of life and maintenance of

health in different circumstances, is not only interesting to the physiologist, the statist, and the political economist, and to all who have the management and responsibility of providing for the inmates of public institutions; but it bears intimately on the ordinary duties of the medical man, on the cure of many disordered conditions, and the maintenance of health and strength under different or conflicting circumstances, as to external influences, and as to expenditure; and I have endeavoured to throw some of the results of the diet tables into a more conclusive shape.

In the first column of the following estimate, animal fibre only is included, whether used as such, or consumed in the form of soup. Milk and all other forms of strictly speaking animal food, are included under the second column, for reasons which may be sufficiently obvious.

ESTIMATE OF DAILY RATIONS.

AUTHORITY.	Rough Weight of Animal Fibre in the Rations.	Rough Weight of Vegetable and other Food in the Rations.	Total Weight of Dry Nutriment.	Total Weight of Azotised Nutriment.
	oz.	oz.	oz.	oz.
NAVY	16	26¾	17½	5½
NAVAL HOSPITALS.				
Full Diet	16	40	20½	6½
Half Diet	8	25½	16½	5¾
Low Diet	1	40	9½	3½
Fever Diet	—	20½	8	2

ESTIMATE OF DAILY RATIONS—*continued.*

AUTHORITY.	Rough Weight of Animal Fibre in the Rations.	Rough Weight of Vegetable and other Food in the Rations.	Total Weight of Dry Nutriment.	Total Weight of Azotised Nutriment.
REGIMENTAL HOSPITALS.	oz.	oz.	oz.	oz.
Full Diet	12	41	20½	5¾
Half Diet	8	33	17½	4¼
Low Diet	4	29	13½	3
Spoon Diet	—	15½	7¼	1½
Milk Diet	—	64	17½	5½
POOR LAW COMMISSION.				
No. 1	4	21¼	13¼	4
No. 2	—	25½	14½	3
No. 3	2	28½	16¼	3½
No. 4	2¼	26¼	18	4
No. 5	2¼	29	14½	3¼
No. 6	1½	25¼	15½	3
CHELSEA HOSPITAL	13	35½	19	5½
EACH SOLDIER OF THE GUARD OVER CONVICTS	16	27½	20¼	6
EACH CONVICT OR SETTLER	11	23½	17	4¾
EACH CHILD OF CONVICT, UNDER TEN YEARS OF AGE	5	13	8¾	2⅛
GAOLS.				
1st Class. Imprisoned for fourteen days, or under	—	36	19¼	3¼
2nd Class. Imprisoned for terms above fourteen days, and under six weeks	3	36	25¼	4
3rd Class. Imprisoned for terms above six weeks, and under three months	3	38	22	4½
4th Class. Imprisoned for terms exceeding three months	4	40½	22½	5
MIDDLESEX HOSPITAL.				
Meat Diet	4	42	19	4
Soup Diet	3	30	12	3¾
Milk Diet	—	48	13	4¼

ESTIMATE OF DAILY RATIONS—*continued.*

AUTHORITY.	Rough Weight of Animal Fibre in the Rations.	Rough Weight of Vegetable and other Food in the Rations.	Total Weight of Dry Nutriment.	Total Weight of Azotised Nutriment.
MIDDLESEX HOSPITAL—*continued.*	oz.	oz.	oz.	oz.
Simple Diet	—	12	8¼	1¾
Cancer Diet	8	36	11¼	6½
NORTHAMPTON INFIRMARY.				
Full Diet	5	33½	14½	4¾
Half Diet	3	33	14	4
Milk Diet	—	45	13	5½
MANCHESTER INFIRMARY.				
Generous Diet	8	48	18¼	5½
Common Diet . . .	4	26½	15½	3½
Milk Diet	—	39¼	13	3¾
Low Diet	—	10	7½	1½
GLASGOW INFIRMARY.				
Full Diet	9½	43	15½	6¼
Middle Diet No. 1 . .	5½	43	14½	5½
Middle Diet No. 2 . . .	5½	24	9¾	5½
Ordinary Diet . . .	1½	41½	13¼	3¾
Spoon Diet	—	14	6½	1¾
Milk Diet	—	52	12	4½
EDINBURGH INFIRMARY.				
Low Diet	—	14	8½	1¼
Rice Diet	8	15½	10	3½
Steak Diet	6	33½	14¾	3½
Common Diet . . .	2	34	13½	2½
Full Diet	8	65¼	19	6
Extra Diet	10	79	23	7¼
REPORT BY DRS. ALISON AND CHRISTISON.				
1st Rate	2	32	12½	4
2nd Rate	2	44	16¼	5¼
3rd Rate	6	44	18	6¼
4th Rate	5	36	15¾	4

If the justness of this estimate as to the different dietaries be admitted to be essentially correct, the conclusions are very obvious, and of manifest im-

portance. Granting that the quality and relative digestibility of the articles of food are indispensable preliminary considerations, the next questions that arise are, how much of animal and vegetable food respectively are necessary to the maintenance of health under certain given circumstances, and how much of dry azotised and non-azotised aliment should such food contain. One quart of soup, however grateful to the palate, and seemingly consistent and substantial, and therefore satisfying to the appetite at the time of eating it, which contains only five ounces of vegetable food, and which, at a high estimate, would afford only four ounces of dry nutriment, and less than half an ounce of azotised aliment, would, even when aided by a very large sized biscuit, be at once seen to be inadequate to the maintenance of health and strength,—even if it might keep a pauper population a single point above actual starvation, and consequent death, during many weeks: the probability being, however, that fever would step in under circumstances of such defective nutrition, to check any triumphant result from such a short-coming benevolence.* It seems from the tabular

* I venture to quote the following, in elucidation and proof of the needfulness and truth of the observations in the text.

"Receipt No. I.—For Two Gallons of Soup.

Two ounces of dripping.

Quarter of a pound of solid meat (cut into dice one inch square).

Quarter pound of onions, sliced thin.

Quarter pound of turnips; the peel will do, or one whole one cut into small dice.

Two ounces of leaks; the green tops will do, sliced thin.

Three ounces of celery.

estimate derived from the different dietaries quoted, that from thirteen to twenty ounces of dry nutri-

Three quarters of a pound of common flour.
Half a pound of pearl barley, or one pound of Scotch.
Three ounces of salt.
Quarter of an ounce of brown sugar.
Two gallons of water.

"I first put two ounces of dripping into a saucepan (capable of holding two gallons of water), with a quarter of a pound of leg of beef without bones, cut into square pieces of about an inch; and two middling sized onions, peeled and sliced; I then set the saucepan over a coal fire, and stirred the contents round for a few minutes with a wooden (or iron) spoon until fried lightly brown. I had then ready washed the peeling of two turnips, fifteen green leaves or tops of celery, and the green part of two leeks; (the whole of which, I must observe, are always thrown away). Having cut the above vegetables into small pieces, I threw them into the saucepan with the other ingredients, stirring them occasionally over the fire for another ten minutes; then added one quart of cold water and three quarters of a pound of common flour, and half a pound of pearl barley, mixing all well together. I then added seven quarts of hot water, seasoned with three ounces of salt, and a quarter of an ounce of brown sugar, stirred occasionally until boiling, and allowed it to simmer very gently for three hours; at the end of which time I found the barley perfectly tender. The above soup has been tasted by numerous noblemen, members of parliament, and several ladies who have lately visited my kitchen department, and who have considered it very good and nourishing."—*Charitable Cookery; or, the Poor Man's Regenerator.* By A. Soyer.

I may add to this, for the sake of those who dislike onions and leeks, that, if these be omitted, and either a larger proportion of celery be made use of, or (which answers just as well) a small quantity of celery seed, an excellent soup is produced, as far as taste and appearance are concerned,—and at a cost which is singularly small, and which reflects in the same proportion much credit on the talents of M. Soyer as a cook. As regards the question of diet and nutrition, however, such a soup occupies a very low position, and illustrates in a remarkable manner the importance of reducing any dietary that may be under consideration, to the quantity of dry and azotised aliment it may contain, before we trust to it as affording sufficient nutritive matter for the support of a population.

ment, and from four to six ounces of azotised aliment, is a needful daily ration for people who have to undergo regular and active exertion; and that less than the lowest of these quotations would be an unjustifiable allowance to adults in health, who are called upon to work. Such an estimate is easily made, and should be considered a necessary step previous to the adoption of any plan of diet for the inmates of public institutions, or the dependants on public charity. The following table, contained in the report of Drs. Alison and Christison, already referred to, contains the more important articles of food commonly needed in such dietaries, and may prove a useful reference :—

SPECIES.	Per Centage of Dry Nutriment.	Per Centage of Nitrogenous Nutriment.
Bread	62	$10\frac{1}{2}$
Oatmeal	82	$18\frac{3}{4}$
Barley	82	15
Peas	80	$24\frac{1}{2}$
Potatoes	27	$2\frac{1}{2}$
Carrots	10	$1\frac{1}{2}$
Cabbage	7	$1\frac{1}{2}$
Turnips	6	$1\frac{1}{2}$
Lean of Meat	27	27
Skimmed-Milk Cheese	65	65
White Fish	21	21
New Milk	12-5	8
Skimmed Milk	10	8
Butter Milk	7	7

"These equivalents have been partly adopted from a variety of good authorities, partly from personal investigations. The nitrogenous ingredients of the articles of vegetable food are founded on the recent analysis of Mr. Horsford, conducted at Giessen, under the eye of Professor Liebig."—*Report.*

In regard to the relative proportion of animal fibre, which should form part of the habitual daily ration of people in health, and undergoing regular exercise, in these latitudes, it may be gathered from the tables that a minimum of four ounces, and a maximum of sixteen ounces, are the extreme allowances of different public dietaries. Excluding the dietaries of gaols and workhouses,—in which the absence of exercise in the open air, and the restriction of free migration, would necessarily reduce the wants of the system,—from ten to sixteen ounces of animal fibre daily might perhaps be fairly assumed to be no more than is a needful allowance for labouring men in the prime of life, and in full health. The just allowance of animal fibre in poor-houses would be reduced by the circumstance, that so many of the inmates may be inferred to be either infirm or aged, and that the able-bodied and vigorous should be offered no temptation to continue to be recipients of the public charity, in the form of any greater amount of food than is sufficient to support existence, without ulterior injury to health and the expectation of life. The relative proportion of animal fibre required in the daily rations, must be much modified by the proportion of milk or eggs, or animal food in any other form, which enters into the scheme of diet. It should be felt, however, that no such other forms of animal food are, in essential points, to be considered to be perfect substitutes for animal fibre, in repairing the waste of the system, and maintaining its power of enduring continuous labour without

undue and unwise cost to the assimilating organs. Supposing it to be proved that other articles of food, whether vegetable or animal, contain the elementary matters that are essential to restore the waste and expenditure of the human system, the re-adjustment of such elements, the forming them into new combinations, whether of simpler or more complicated character, must be so far an additional task for the digestive and other assimilating organs, so far an additional source of organic expenditure, so far necessitate a deduction from the eventual restoration of the waste of the economy, and so far involve a risk lest any failure of assimilation may lead to a corresponding proportion of such food being in no degree conducive to the nourishment of the body.

These views of the importance of animal fibre as a part of the ordinary diet of a healthy and active man, are confirmed fully by the researches of Baron Liebig.* Supposing the flesh of animals to have an acid reaction, whereas even the blood itself exhibits alkaline characters; and that flesh affords no less than five organic compounds, of distinctive properties and composition; and that flesh differs, moreover, from the blood, in having potash instead of soda for the principal base of its saline constituents; it follows that to form flesh, and maintain its integrity, notwithstanding the wear and tear of the ordinary organic processes, and the further wear and tear of muscular exercise, from almost any

* "Researches on the Chemistry of Food. By Justus Liebig, M.D., &c.—Edited by Dr. Gregory."

other nutritive material than animal fibre, must require much additional effort on the part of the organs of assimilation. And the animal machine can hardly be kept in full tone and condition, in the greatest possible aptness to undergo and endure full muscular exertion, without a corresponding proportion of animal fibre forming part of the daily food. It is a very curious fact, that most of the vegetable articles of food contain potash as the principal alkali of their saline constituents, and that the same is the case with the flesh of animals; whereas the blood contains and requires soda as its principal saline base,—as it is believed, chiefly with a view to the remarkable property of the phosphate of soda in absorbing and giving off carbonic acid with great facility, with the double intention of relieving the system of its carbon, and of ministering it readily to the calorific wants of the system.

In noticing these researches of Professor Liebig, it may be added, that as flesh contains from seventy-six to seventy-nine per cent. of water, and from two to three per cent. of soluble albumen, there are only about twenty per cent. of fibrin and other less soluble matters. "And it appears from these researches, that by the boiling of flesh an essential change in its composition is effected. According to the duration of the boiling, and the amount of water employed, there takes place a more or less perfect separation of the soluble from the insoluble constituents of flesh. The water in which flesh has been boiled contains alkaline phosphates, lactates, and

inosinates, phosphate of magnesia, and only traces of phosphate of lime; the boiled flesh contains chiefly, with the fibrin, &c., the insoluble inorganic constituents, phosphate of lime and phosphate of magnesia. It is obvious that if flesh, employed as food, is again to become flesh in the body, if it is to retain the power of reproducing itself in its original condition, none of the constituents of raw flesh ought to be withdrawn from it during its preparation for food. If its composition be altered in any way, if one of the constituents which belong essentially to its constitution be removed, a corresponding variation must take place in the power of that piece of flesh to re-assume in the living body the original form and quality, on which its properties in the living organism depend." *

* M. Liebig goes on to show, that boiled flesh, when eaten without the soup formed in boiling it, is so much the less adapted for nutrition, the larger the quantity of the water in which it has been boiled, and the longer the duration of the boiling. He says that when finely-chopped flesh is extracted with cold water, it loses the whole of the albumen contained in it; and the residue, after being well washed with cold water, is found to be perfectly tasteless when boiled with fresh water. It is inferred that all the sapid and odorous constituents of flesh exist in the flesh itself in the soluble state, and that the smell and taste of roasted flesh arise from these soluble constituents, which have undergone a slight change under the influence of the higher temperature. "The liquid which is obtained by lixiviation of the different kinds of flesh with cold water, after it has been heated to boiling, and the albumen thus coagulated, possesses, in all cases, the well-known general flavour of soup; but each kind, individually, has, besides this, a peculiar taste, which recalls the taste and smell of the different kinds of flesh; insomuch that, when to boiled beef, for example, the concentrated cold aqueous infusion of roe-deer venison or of fowl is added, and the whole warmed together, the beef cannot then be distinguished from the venison or the fowl." Supposing, however, that

When the absolute and relative bulk, weight, and importance of the muscular system in man are considered, and the direct way in which muscular substance used as food must minister to the maintenance and restoration of the integrity of this system are by these views more fully appreciated, the importance of animal food, and especially of flesh, in the diet of man, becomes obvious and explicable. It is not, that the kreatine, the kreatinine, the sarcosine,

the taste and flavour of flesh depend on the soluble parts, and that these are chiefly composed of albumen or mixed with it, the fibrin, which seems to be comparatively destitute of appetising qualities, is at least as nutritious and as important to the economy of the system when used as food. Soup cannot under any circumstances represent all the nutritive qualities of meat; although it may represent, according to these views, all the odorous and sapid qualities of the flesh it is prepared from. In the case of roasted flesh, inasmuch as none of the soluble ingredients have been removed from it, all the conditions of nutrition seem to be as far as possible fulfilled. In the case of boiled flesh, if the meat is to be the principal consideration, it is evident that it should be introduced into the water when the latter is actually boiling, to secure the coagulation of the albumen near the surface, and the smallest possible solution of it in the water made use of; and lest the continued high temperature should have too hardening an influence, so much cold water might in a very short time be added, as would reduce the temperature of the water to 165°, at which the whole should be maintained for as many hours as may be needful to cook the flesh thoroughly. It seems that the requisite changes required by cookery do not take place in the ordinary red meats at a lower temperature than 144°, nor in the white fleshed meats, as fowls, at a less temperature than 130° to 140°. If, on the other hand, the object be to extract from the meat all its soluble and sapid material, the obvious deduction is to cut and pound it into a sausage meat, steep it in cold water,—say of an equal weight,—heat the water slowly to the boiling point, and after a brisk ebullition of a few minutes, strain the liquid through a cloth, to separate it from the coagulated albumen and the hard fibrinous matters,—colouring and flavouring this extract of flesh according to taste.

the inosinic acid, &c., obtained by Baron Liebig from the flesh of animals, may not be formed from any kind of food containing their indispensable constituent elements, by the vital and organic powers of the animal economy; and accordingly, where the expenditure of the system is small, either from climate or habits of life, we know that life subsists,—and the system, and the muscular system among the rest, is restored, and maintained in health and medium vigour,—without animal food forming any large or regular or influential part of the diet, and with a small or even without any allowance of flesh meat in any form. But it is, that to form muscle, and therefore to form all the complicated chemical compounds which are shown to be the constituents of muscle, more efforts must be made by the organic system, and a correspondingly greater expenditure of power occasioned, than if the constituents of muscle were offered to the organs of assimilation in the form of muscle itself. In the same way as I believe, that, under a special exigency, muscle may be formed from gelatin, and as we know that fat is formed from all the amylaceous and saccharine substances, may it be inferred that muscle may be formed from its elements by the powers of the system. In such a climate as that of Great Britain, and in a country where the energies of the system are desired to be wasted as little as possible in the maintenance and reproduction of the animal frame work, the importance of a mixed diet, containing animal food, and especially flesh, as a needful ingredient of the dietary, becomes

a matter of sufficiently clear demonstration. The analogy, however, as to the essentials of elementary composition, between the fibrin, albumen, and casein of animal and vegetable substances, must not be forgotten; nor the consequent power of the system to convert them respectively into one another; required as this view is by dietetic observation, and supported as it is by chemical researches.

It becomes very obvious, from all that has been said and cited, how great and important must be the modifications of different dietaries, according to age, sex, habits of life, climate, and season. In infancy and early childhood, the respiratory, and consequently the hepatic wants of the system, are more important and considerable, the muscular and organic wants and movements comparatively small; and a diet consisting in great part of amylaceous and saccharine matter meets the bodily expenditure, and maintains the integrity of the organism. As life passes on, during the years of growth, the respiratory expenditure continues to be very large; the hepatic system is still very active; the skin and the lungs emulge much aqueous matter, to preserve the temperature of the body as nearly as possible at an equilibrium; and (notwithstanding the proverbial activity of childhood,—largely as this is balanced, however, by the much longer periods required for sleep than are needed in after life, and notwithstanding the wear and tear of muscular substance, and notwithstanding the demand occasioned by the constant and great additions made to the size of all

the organs and tissues of the body) the conditions as to the wants of the economy are for the most part sufficiently fulfilled by a diet, consisting almost exclusively of milk and the different farinaceous articles of food. In mature life, although the respiratory wants of the system are less, the growth of the body has no longer to be provided for; the maintenance of its integrity from the effects of waste and expenditure, and the supply of carbon for the purposes of respiration and temperature, have alone to be provided for; and, unless under very peculiar circumstances, the vegetable articles of food, and more particularly the farinaceous articles of food, continue to fulfil the principal dietetic indications; and no more animal food seems to be necessary, than may serve to restore a certain amount of the extraordinary expenditure, that is occasioned by exercise of the locomotive powers, or by any other extreme exertion of nervous or organic function, that involves a large expenditure of azotised material. And thus the difficulty and risk of securing a due allowance of animal food, and no more than such a due allowance, as may serve to equalise the supply and the expenditure of the economy; and avoid an undue call upon the organs of assimilation to convert vegetable food into muscular substance on the one hand; or so ready and full a supply of ready-prepared fibrinous aliment, as renders the supply of azotised material afforded by the other articles of food, when deprived of their carbonaceous matter for the purposes of respiration, &c., at once needless, and a possible source of plethora,

and ultimate morbid action. In this way, in warm climates and warm seasons of the year, the consumption of respiratory carbon being so much less, and the amount of motor power required for the purposes of the circulation being so much smaller, and the general activity of the nervous system being so much diminished from what obtains in colder latitudes and seasons, the expenditure of carbon and nitrogen is so much smaller; and animal food, or even farinaceous food, has to be largely replaced by more aqueous vegetable aliments,—or the system becomes plethoric, the organs overworked, and eventually oppressed,—and disease ensues. Under any circumstances, however, as to climate, season, habits, occupation, age, or sex, it may be taken as a general rule, admitting of few exceptions, that the system must be generously dealt with in regard to food, and not restricted to the mere quantity that appears to meet the absolute wants of the economy; or such a state of system will be induced, as forms the most common predisposing cause of disease,—rendering the body peculiarly liable to suffer from exposure to any of its immediate or exciting causes, whether cold, or miasms, or changes of weather, season, or climate. Man was destined to work for his food; and was accordingly formed to require such an amount of food, as would support the expenditure of a life of labour. People may indeed go on existing, for indefinite and long periods of time, upon much less food than that now referred to, and therefore need less enforced expenditure of the waste and redundancies of the system; but

they will not be in vigorous health, if their state of system deserves the name of health at all; and their state of body is exactly that, in which the seeds of cachexia are most readily laid,—or in which inflammatory affections are the most readily set up,—or in which malaria or contagion find their readiest victims. And, moreover, their condition of system is exactly that, in which the powers succumb most readily to the effects of morbid action; in which, if inflammation be not so high, nor so active, as when it attacks the man in full and vigorous habit, it yields less readily to treatment, and leaves behind it consequences the most injurious and least remediable.

The effect of the mind on all the digestive processes, and of these in their turn on the mental capabilities, is a very full subject; and one that must be adverted to, however shortly. To what an extent, unexpected news, whether involving great excitement or great distress of mind, takes away, on the instant, all appetite and relish for food; and, if food be taken under such circumstances, how certain it is to be followed by dyspeptic indications; are matters of every-day observation. That distressing tidings, received after an ordinary meal of food, leads to indigestion, and much stomach-disturbance,—that all the ills of dyspepsia may be at once removed, by whatever acts pleasingly and fully on the mind,—that dyspepsia, in its turn, enervates the mind's powers, and distorts its views, lowering its tone, dwarfing its capacity, or, in some way tinging, perverting, or lessening, the mental capabilities,—

mercantile vicissitudes, the different scenes and trials of life, and the lives of men of genius, abundantly illustrate. Among the more important of the practical suggestions, which these observations lead to, is that of the importance of the dyspeptic living and mixing freely with cheerful society. The solitary meal, and the consequent rapid eating, with the mind absorbed by the weighty cares, and uncheered by the amenities, and reciprocal feelings, and interchange of ideas, and harmonies of social intercourse, have produced no few cases of dyspepsia, that, in their turn, have involved no few cases of more serious disease. It should, then, be a serious matter, that would justify such an alteration of the invalid's meal-times, unless under the pressing exigency of acute disease, as takes him away from the family meal, and consigns him to eating his food alone. It should be no light matter, that justifies a severe mental effort, or laborious thought and abstraction of mind, soon after an ordinary meal of food; and in the same way as, if a man were to undergo violent muscular exercise soon after eating, his meal should be sparing in quantity, and especially digestible in kind, so the man who has such mental efforts to make, should be careful that the meal of food correspond, in the smallness of its quantity, and its easy digestibility, with the mental labours before him, and the consequent diversion of nervous power from the stomach to the brain; or otherwise be prepared to allow so long an interval of time, between the meal and the mental effort, as will enable the nervous

energies to be sufficiently expended on the digestive process, to secure its being duly performed. This is the more important, from the fact of the great bodily exhaustion, and consequent appetite, which so notoriously follow mental exercises, when not carried too far. If the mind's powers, indeed, have been tasked unduly, the stomach and general system may be so far exhausted, as that the appetite may be lost, together with the chance of whatever food is taken being duly digested; precisely as is found to obtain after any other way, such as common bodily fatigue, by which the powers of the body are much expended. But if the mental labour have not been to such an exhausting degree, as great an appetite is often induced by it, as by a full but not excessive degree of bodily exertion. In fact, by both is the azotised matter of the system expended; by both is the expenditure of the organised atoms effected; and by both is the necessity of alimentary supplies of new materials produced; and, perhaps, by both in an equal degree. The question, so far as dietetic regulation is concerned, is dependent on the degree to which mental labour has been undergone. If it has been only moderate in degree, the expenditure may be wisely made up for at once, by a suitable meal. If the mental labour has been carried to a more exhausting degree, the propriety of taking food at all, without a longer or shorter interval of repose, may be fairly questioned; and the quantity taken be very needfully restricted; and its quality be properly confined to the simplest, and most easily

digested kinds of food. The importance of a reasonable interval of rest, after severe bodily or mental labour, before sitting down to a meal, can hardly be exaggerated. Of course, the more feeble the individual,—the more morbidly sensitive, easily deranged, and deficient in tone, his digestive organs,—the more important is the rule, and the longer should this interval be. And sometimes, as in cases of great debility, even when no further exertion has been made than that involved in sitting in a chair, I have found it very serviceable, to direct the recumbent posture, even with sleep, when that has been practicable, to precede the different meals of the day; and in less severe cases, after common mental or bodily exercise, the same has been enjoined with good effects. This is, of course, a simple question of degree; and is by no means intended to justify, either the recumbent position for some time before dinner, or the indulgence in sleep at that time of the day, when the amount of labour on the one hand, or of debility on the other, does not show it to be desirable.

The usefulness and necessity of rest, both of mind and body, after food, hinge likewise on the state of the digestive organs, the powers of the general system, and the kind and quantity of food that has been taken. The strongest and most healthy should remain at rest for some time after a heavy meal; and the more feeble the digestive powers, or the weaker the state of the system, or the greater the amount of mental or bodily exertion to be thereafter

undergone, the more important and the longer ought this interval of rest to be. However justifiably, under extreme circumstances, a mid-day sleep may be allowed, or prescribed, before a meal, it is almost always unwise to permit this to be indulged in after a meal. By this, the powers are not refreshed; but, on the contrary, the digestion of the food is deranged, and the nervous system by so much irritated; while the circulation of the blood is interfered with, as well mechanically by the fulness of the stomach, as by an undue derivation of blood to the stomach; and oppression and crudity reciprocally aggravate the consequent derangement of the economy. To sleep after a meal, makes easily-digested food, and a very feeble system, necessary conditions, if the prescription is justifiable, and the result advantageous. The mutual bearings of sleep and the digestive processes, will, however, have to be taken notice of again, in a subsequent chapter.

To return to the consideration of the best hour for the dinner, it must be admitted to be so far complicated, and so far dependent on different circumstances, that it may justifiably differ a good deal in different cases. Granting the importance and truth of the general rule, that the longer the interval between the second great meal of the day and the bed time, supposing it to be eaten at a sufficient interval of time after the breakfast, the more desirable it is for the due performance of the great processes of assimilation,—nevertheless, if the dining at one or

two o'clock P.M. involves the eating the meal solitarily, instead of amidst the cheering influence of the family circle and social relaxation,—or if the dining so early in the day must be followed by an immediate return to the mental or bodily labour, without any sufficient interval of rest,—it may be more than doubtful whether the prescription is not unwise, and does not substitute a greater for a smaller evil. In general, unless under circumstances of much dyspepsia, a somewhat later hour of dinner is seldom sufficiently objectionable to justify either a solitary meal, or the loss of some short interval of rest after the food has been swallowed; and, usually, even in cases of decided dyspepsia, attention to the quantity and quality of the food will be sufficient to remove the derangement of the digestive organs. If the dinner, then, is put off, for such sufficient reasons, till later than five hours after the breakfast, some luncheon becomes advisable, and indeed necessary. The stomach, it may be repeated, should never, unless during sleep, be longer than five hours without some kind of food being taken, and more especially during the early or mid hours of the day. The luncheon, ought, however, to be so simple, and consist of such quickly and easily-digested materials, and contain so small a quantity of nutriment, as will not interfere with the powers of the digestive organs when the hour of dinner arrives; and it should only be sufficient to prevent that degree of languor, and that extreme degree of appetite, which, when the fast from the first to the second meal is longer than five

hours, almost always leads to the eating an undue quantity of food at the dinner; while it so far enfeebles the powers of the stomach, as to diminish, in an important degree, the probability of its being duly digested without local disturbance, or disadvantage or derangement of some other function of the body. A biscuit, or crust of bread, may be sufficient to answer every needful purpose, when the fast is not very long, or the amount of mental or bodily exertion is not severe; and when the dinner hour is necessarily late, or the day's duties laborious, the amount of the food eaten at luncheon must be proportioned thereto,—care being taken that it is rather kept within the point of moderation, than allowed to exceed it. If the dinner hour is unavoidably a late one, and the day's work fatiguing, or the system somewhat feeble, or the digestive powers not vigorous, or deranged considerably in their functions, the question arises whether even a solitary early dinner, with all its admitted disadvantages, should not be, at least temporarily, had recourse to; making, perhaps, the ostensible dinner rather a pro formâ and light meal, than one of the two more important meals of the day.

The probable necessity for supper, which is occasioned by dining early in the day, constitutes the only objection to the early dinner, which is, on most other accounts, so much more desirable. If, however, the breakfast and the mid-day meal have consisted of sufficiently nutritious food, and been made to comprise so large a proportion of the day's

sustenance, as has been advised,—very little solid food will, in most cases, be found to be necessary afterwards; and the supper may be of such articles, as would be little likely to task the powers of the stomach unduly, to interfere with the sleep, or to prove eventually disturbing to any of the assimilating organs. If the dinner be taken so early as one o'clock in the day, some solid food may, indeed, be required between that and bed-time, which may be ten, or possibly eleven, hours afterwards; and especially, if this long time have been spent in active mental or bodily exertion. In this case, the remainder of the day's food may be usually taken at tea-time, and several hours have to pass by between that and the bed-time. In cases of decided dyspepsia, however, it will be, usually, better to take the tea by itself, without solid food, as has been already mentioned, about three hours after the dinner; the real third meal, or so called fourth meal, the supper, being taken about seven or eight o'clock in the evening; and possibly made to consist of any simply farinaceous food,—such as bread, or biscuit,—or rice, sago, arrow-root, &c., in any acceptable and simple form. Recent vegetables or fruits on the one hand, or solid animal food on the other, are wisely forbidden in the supper of the dyspeptic; and there are few cases of any kind, as has been already said, in which the alcoholic compounds should not be strictly forbidden in the later periods of the day,—and the later in the day, the more strongly should they be objected to.

There are certainly, however, some cases, in which

supper is justifiably erected into a more important meal than this, and in which some substantial food is properly allowed. Such cases are, perhaps, sufficiently marked by the sense of exhaustion experienced during the night, and the disturbance of the sleep, together with much flatulence, and other indications of undue fasting. There may often, indeed, be some doubt as to whether the symptoms are not owing to too little, or a too acrid, or a difficultly assimilated kind of food, having been taken at the early meals,—even although the uneasy feelings may be at once subdued, refreshing sleep obtained, and the recurrence of such symptoms prevented, by a meal of food being eaten late in the evening; and, at all events, care may be taken, that such supper is eaten at least two or three hours before the bed-time, and the risk of ultimate interference with the processes of assimilation, in this way lessened, as much as possible.

Food ought seldom to be eaten between the meal-times, and only under very peculiar circumstances. As the food seldom leaves the stomach in less than three hours,—and more usually, especially if the powers of the stomach are somewhat impaired, remains in it four or five hours,—the addition of undigested food to the partially chymified mass, interferes with the complete and due performance of the stomach's duties.

These general observations on diet may be fitly concluded by a rapid summing up of some of the opinions that have been offered. The amount of

every man's food, however strong and well he may be, should be measured and regulated by the expenditure and consequent wants of his system, and by the amount of exercise, whether of mind or of body. His food should be eaten at stated and regular times; and, unless during sleep, he should never fast longer than five hours. This is more important in the early, than in the later parts of the day. The breakfast should be, in most cases, the principal meal. The large proportion of the day's sustenance should be taken early in the day. All the alcoholic liquids should be avoided as much as possible:—

> "Tho' I look old, yet I am strong and lusty;
> For in my youth I never did apply
> Hot and rebellious liquors in my blood,
> Nor did I with unbashful forehead woo
> The means of weakness and debility;
> Therefore my age is as a lusty winter,
> Frosty, but kindly."
>
> As You Like It. *Act II. Scene* 3.

As little liquid as may be, should be taken at the second, or mid-day meal,—probably, after all, the most nourishing meal eaten in the day, and the one which taxes most his digestive powers. The food should be eaten slowly; each mouthful being well and carefully masticated, and mixed intimately with the saliva. The dinner should be confined, as much as may be, to one or two dishes. Little or no supper should be eaten; and food should seldom be eaten within two hours of the bed-time. Thus living, a man will be fulfilling his duty to his

health; adding to his chances of life, and to the probabilities of his prolonged usefulness, so far as his diet is coneerned; and so far, be taking the best means of warding off disease. If already dyspeptie, more care than these rules involve, will be needful to him. The effect of every artiele of food upon his stomach, its eomparative digestibility, and consequent wholesomeness, should be observed; his diet should be strietly confined to a single dish at every meal; and that must eonsist of what his stomach can digest without pereeptible inconvenience,—if he should, to secure this end, have to be forbidden the use of animal food, &c.,—and be confined to the most simple and least irritating kinds of farinaceous food. And, having reaehed that point in the scale of comparative digestibility, at which the food is found to agree with the stomach, the needfulness of restricting himself to that point should be impressed upon his mind, until, by such means of quiescence, and lessened irritation of the organs of assimilation, and such other means of health, whether hygienic or medieinal, as may be indieated, the stomach has regained its tone, the gastrie secretions again become equal to their great duties, and the proeesses of assimilation been restored to a healthy and normal state; when the steps should be retraced with caution and judgment, until he is again entitled to live, judiciously and temperately, on the various kinds of food, whieh civilisation and commerce have brought within his reach; avoiding, as eommon scnse dircets, those irregularitics, or other errors, which may have, in the

first instance, produced, or contributed to the dyspeptic symptoms.

The adaptation of the general principles of dietetics, and all we know or have to learn of the chemistry of food, and the chemistry of the human system, to the treatment of different diseased conditions, must be regarded as no secondary duty of the medical man, and no inconsiderable and unimportant means of restoring health and preserving life. The importance and needfulness of the antiphlogistic regimen,—including a diet that is principally aqueous, and containing exclusively farinaceous aliment, and that in a minimum quantity,—have always been admitted and enforced; but more than this assistance in the treatment of disease, and the fulfilment of its indications, may be more and more looked for from dietetic researches. The dietetic management of the scorbutic, purpuric, anæmic, cachectic, and arthritic, conditions of the system, by corresponding modifications of diet, may be already adduced, as significant illustrations of the practical good that may be looked for in this direction, by further researches and a more zealous attention to this important department. Indeed, without a rational adaptation of dietetics to chronic as well as acute diseased conditions, their treatment must be rendered by so much more difficult, tedious, and uncertain,—even if the chances of restoration to health be not otherwise wholly done away with. A form of modern empiricism, unquestionably owes the proportion of success that has attended it, to such dietetic management,—and not to the infinite-

simal doses of silica, and the like; and this may be fairly adduced as an illustration of how much dietetic management may effect in the cure of certain morbid states, without the assistance of any strictly medicinal treatment whatever. By simple attention to the quantity and quality of the daily rations, the number of the blood globules may be diminished or increased,—and febrile or inflammatory states moderated or even removed,—or an anæmic condition cured; by a modified vegetable diet, the scorbutic condition; by a mixed diet, the purpuric condition; by a fibrinous diet, the anæmic condition; by a milk diet, the cachectic condition; by a less azotised diet, the arthritic condition; may be respectively relieved, in an important degree, without the aid of drugs; and, in many cases, it cannot be doubted, be more effectually and permanently influenced by such means.

The dietetic management of children during all the years of growth,—and especially of the children born and bred in cities, exposed necessarily to the physical disadvantages of a deranged atmosphere, and the like,—is another great and important branch of practical dietetics; and one, in which greater and greater advances may be expected to be made. The avoidance of a dietary that is unduly stimulating on the one hand, or defectively nutritious on the other; the maintenance of power, the restoration of waste, the provision for the growth, with the least expense to the organs of assimilation, the least risk of irritation to the excitable mucous tissue; are obvious

points to be arrived at by dictetic management,—and to secure whieh must be a sanatory gain of no seeondary importanee.

The question as to the usc and abusc of the alcoholie stimulants, is a third mattcr of mueh moment in the treatment of different morbid conditions, and in the management and preservation of the health of people, who begin lifc, or who have to maintain life, under such very different eircumstanccs, as the producing and the eonsuming, the thinking and the toiling, the city-pent and the rural elasses. To the rational medieal man, who weighs well these different eonditions, who sces disease so often procecd from, or so often aggravated by, conditions that habitual or oceasional stimulants are alone able to counteract, or which may be most readily, or most surely and safely, thus antagonised and relieved, the question of teetotalism, in its attempted general application to all ranks and eonditions of the people, must show itself to be unbased on sound theory or just praetieal inferences.

Thc question as to the feeding of the indigent, the siek, the aged, and the labourer, brings thc subjeet of dietaries within the direet influenee of the Legislaturc, and renders its dctails and faets of inappreciablc value. There can bc no question, that, by dietaries which have bcen unequal to the wants of the systcm, or havc not been adaptcd in eharaeter to the attendant eircumstances of the lifc, discasc, in its worst and most fatal forms, has becn, many timcs, indueed, in plaees of punishmcnt, of well-intcn-

tioned charity, of manufacture, and of education; or that, without constant recurrence to the principles of dietetics, such occurrences may be reasonably expected to occur again. It is only a knowledge of the ordinary and the extraordinary expenditure of the system, of the varying expenditure dependent on age, season, climate, toil, &c., and of the nutrimentary qualities of different kinds of food, that can afford a secure basis for the establishment of useful dietaries, and adjust their modification to suit the various requirements of the economy under different circumstances.

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